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☞ An asterisk (*) denotes an illustrated article

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WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

Subscribers would confer a favor upon us by remitting *CHECKS*, or *POST OFFICE MONEY ORDERS*, as we are frequent losers where money is enclosed in letters.

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FIFTH ANNUAL MEETING OF THE AMER. GAS LIGHT ASSOCIATION.

The fifth annual meeting of the Association will be held at Cincinnati, O., on Wednesday, Oct. 17, 1877. Members are requested to prepare papers on any subject connected with gas matters, and to confer with the Secretary concerning the same. CHAS. NETTLETON, Sec'y., 117 Broadway, New York.

THE LOWE GAS PROCESS.

S. A. STEVENS & CO., SOLE AGENTS.

ROOM 87, ASTOR HOUSE, P. O. BOX, 1110. NEW YORK.

(430 Walnut Street, Philadelphia.)

NEW YORK, July 7th 1877.

To the

Editor, Proprietors and Publishers of the American Gaslight Journal:

After declining space in your issue of July 2nd for the correction of some mis-statements in your editorial of the preceding number, I am greatly surprised to find in the later one, (July 2nd.) embodied in an editorial article & conspicuously printed on your first page, a letter purporting to have been written by me & dated at my office *No such letter in whole or in part, or in any degree of resemblance was ever written by me or any of my associates, or with the knowledge or authority of any of us.*

As the publication of this fictitious communication is calculated to do our business a serious injury by casting an imputation of bad faith upon our operations it seems to me that you should have exercised the greatest care in ascertaining its authenticity before admitting it to your columns. I call upon you therefore as an act of justice to all concerned to publish this denial in your next issue, July 16th., on the first page thereof, accompanied by an explanation of the matter & a statement as to the source from which you derived the so-called letter in question.

Respy.
GEO. S. DWIGHT.

We take pleasure in presenting the above communication to our readers from the fact that Mr. Dwight seems to have drawn an entirely wrong inference from our article to which he refers. He states above that the letter referred to, purported to have been written by him.

Now, we can see no such purport in the letter; and, in fact, on the contrary, it appears upon the very face of it, to have been written by some one else. Otherwise the allusion to Blank & Co. being no longer willing to give absolute guarantees, &c., would have no meaning. We never supposed that Mr. Dwight wrote the letter. We never said that he did. We were quite sure he did not write it, and now Mr. Dwight says himself that he did not write it, and that settles it.

No; we looked upon that letter simply as one written from one friend to another, somewhat widely separate, perhaps, showing how to organize opposition gas companies. It developes a general plan of operations in that line, subject, of course, to proper variations in different places according to local circumstances. That is all—it would apply to any process. It is not a letter about *making gas*, but it is a letter about making gas companies.

Now, we have never believed in multiplying gas companies in any one community, and the reasons for that belief we have often given; but here seems to be a sort of general scheme for multiplying organizations with all its attendant evils of stocks and bonds multiplied *ad libertum*. This is a very important matter to the people who already have invested capital in the gas business; and, as many of our readers are people of that class, we laid this matter before them. The only singular thing about the latter, is in view of Mr. Dwight's statement above, is that the letter should have been dated from Mr. Dwight's office, and that below the singular should have been the P.O. Box, No. 1110, the same as on the above. This is, doubtless, a mere coincidence.

So far from in any way disparaging the Lowe process, the writer of the letter seems to think highly of it; and, in fact, speaks of it in most glowing terms. We have no desire or intention of doing any man an injustice, and we are sorry that Mr. Dwight should feel that we had ever treated him in any other way than justly.

Any connection between the scheme set forth in the letter, and any gas process could only begin after the organization of the gas companies under the scheme. But, if we remember correctly, there was some correspondence last spring with the city authorities here, with a view to getting the privilege of lighting the city, in which something was said about organizing a company, provided the city would agree to contract with them; and we have been told by parties, who ought to be versed in such matters, that in Baltimore, and Harrisburgh, and Lancaster, a course very similar to the one worked out in that letter, as to getting concessions, getting consumers committed by signature to using the gas, &c., has been very closely followed. But it does not, from that fact, follow thaat Mr. Dwight did it all. And really, upon reflection and rereading the letter, we must come to the conclusion that Mr. Dwight did *not* read the letter carefully, and that if he had he could not, with any reason, have assumed that it purported to come from him. And we think a little closer reading would have shown him that here was a glowing puff for the process which he claims to manage, and that if he had no knowledge of this method of organizing gas companies, he

might get some useful hints therefrom. We have every reason to believe that the letter was a genuine one, or of course we should not have published it. As to the authorship, Mr. Dwight is certainly entirely freed from that, and the matter seems to us to be scarcely worthy of so much remark even as this.

A NEW WORK ON COAL GAS.

We have received through the courtesy of the publishers, Messrs. E. & F. N. Spon, a copy of Mr. William Richards' new work on the manufacture and distribution of coal gas. It is beautifully printed in large type, and beautifully illustrated.

The book contains 364 pages of printed matter, and this is followed by 29 plates, showing different retort settings—scrubbers, gas-holders, plans of works, &c., &c. Among the contributers to the volume is found the name of Mr. Lewis Thompson, whose reputation for clearness and correctness is so well known. This book will be a valuable addition to the library of every gas manager.

THE ATLANTIC DOCK IRON WORKS.

We are informed tnat the proprietors of the Atlantic Dock Iron Works propose to retire from the business in which they have so long been engaged. As will be seen from another column, they offer their entire plant, good-will, &c., for sale.

The withdrawal of this company from the business of building gas works, machinery, &c., will remove from that line of work, one of the oldest and most successful firms engaged in it.

THE WEST OF SCOTLAND ASSOCIATION.

In another column will be found the proceedngs of this association at their last meeting, and we trust our readers will find the report of Mr. Aitken and Young's proces of condensation, of much interest.

On the Purification of Coal Gas.

By Dr. H. Bunte.

[Translated from *Journal fur Gasbeleuchtung.*]

The *removal of carbonic acid* from coal gas constitutes a part of gas purification generally. The natural purifier for the gas is the ammonia produced in the distillation of coal, which of itself performs in some degree the function of a purifying agent, by converting into ammonic carbonate and sulphide the gases CO_2 and SH_2, which of themselves are scarcely soluble in water.

But the quantity of ammonia produced from the coal is small compared with that of the gases CO_2 and SH_2, though it varies much according to the proportions of nitrogen, sulphur, and water contained in the coal employed. Generally the quantity of ammonia produced will be only a fractional part of the carbonic acid and sulphuretted hydrogen; from the analyses made, the volume proportion of ammonia to the carbonic acid, plus sulphuretted hydrogen, may be taken as from 1 to 4 to 1 to 6.

The ammonia unites with the CO_2 and the SH_2 in simple proportions, apart from intermediate combinations which arise during the combination of CO_2 and SH_2. The simplest relations are as follows:

1 vol.	2 vol.		Neutral salt.
CO_2	+ $(NH_3)_2 + H_2O$	=	$(NH_4)_2\,CO_3$
1 vol.	+ 1 vol.		Acid salt.
CO_2	+ $NH_3 + H_2O$	=	$NH_4\,CO_3\,H$
1 vol.	2 vol.		Ammonium sulphide.
SH_2	+ $(NH_3)_2$	=	$S\,(NH_4)_2$
1 vol.	+ 1 vol.		Ammonium sulphohydrate.
SH_2	+ NH_3	=	$NH_4\,SH$.

But the combination of carbonic acid or sulphuretted hydrogen with ammonia will only take place within comparatively narrow limits of temperature. Beyond these limits the mixed gases show very little, or no, disposition to unite. Carbonic acid, water, and ammonia will only unite at temperatures *below* 58°* to form a carbonate, while at this temperature, carbonate of ammonia is decomyosed into its constituents—CO_2, H_2O, NH_3. This process is called dissociation—decomposition or cessation of chemical affinity, by increase of the elasticity of the gas (or vapor) through increased temperature.

A similar proceeding takes place with sulphuretted hydrogen and ammonia. Bineau, Deville, and lately Horstmann, among others, have shown that, in a mixture of sulphuretted hydrogen gas with ammonia gas, at temperatures above 57°, no chemical union of the two gases takes place. Their union only occurs at lower temperatures and gradually. Analogous proceedings take place when water is present, except that the temperature of decomposition is different.

The combinations formed are soluble in water; if the temperature of decomposition is exceeded, the component gases are liberated in proportion to their co-efficients of absorption, which are rather complicated functions of temperature, and are influenced by the presence of other gases in a way not yet sufficiently understood.

These last-named relations play an important part in Hills's process for regenerating ammonia water by heating the solution, and afford a clue to the peculiar behavior of the ammonia salts during the process.

From the above description of the behavior of ammonia salts, it follows that the gases CO_2, SH_2, NH_3, contained in raw gas, during condensation gradually form into salts, which are dissolved in the water formed at the same time.

As a basis for the following considerations, let it be assumed that the volumes contained in raw coal gas of

NH_3	CO_2	SH_2
are as 1 :	4 :	2 respectively, so

that the coal gas contains—

0.5 p. ct. 2 p. ct. 1 per cent. of these different constituents.

As carbonic acid and sulphuretted hydrogen act in exactly the same manner under the circumstances to be considered, we will confine our attention to carbonic acid.

It appears from the above-named combinations—

1 vol. NH_3 : 1 vol. CO_2 = acid salt.
2 " " : 1 " " = neutral salt,

compared with the proportionate volumes existing in the coal (1 vol. NH_3 : 4 vol. CO_2), that a much greater quantity of carbonic acid exists in the coal gas than is requisite to form an acid salt—viz., four times as much, and for a neutral salt eight times as much. It, has, therefore, been concluded that the gas liquor contains acid ammonic carbonate. This will, in fact, generally be the case if gas liquor is used in the scrubbers, and if all the condensed water is allowed to run into one tank. But, if separate samples are taken from the liquor condensed in different parts of the work, examination will reveal not only a great variation in the content of ammonia (generally increasing with the distance from the retort and with refrigeration of the gas), but also a great difference in the proportion of carbonic acid to ammonia. Further on a method will be described for easily and quickly determining the proportions of carbonic acid and ammonia (and, similarly, SH_2 : NH_3). Such an examination proves that the ammonia water from the hydraulic and from the condenser usually contains no acid carbonates, although a large surplus of carbonic ocid is found; but, on the contrary, besides *neutral* salts, *free* ammonia is found in this water.

The circumstance is easily explained from the above-named properties of ammonic salts. At the temperature of the hydraulic and of the condenser only part of the gases can unite to form salts; the uncombined gases dissolve in proportion to their co-efficients of absorption corresponding to the temperature, and as the co-efficient for ammonia is much greater than that for the other two gases, the medium of absorption—namely, the gas liquor—is found to contain free ammonia precipitated from an atmosphere charged with carbonic acid gas.

In the scrubbers wetted with gas liquor, a small quantity of acid salt was found along with much neutral salt. On the other hand, it is known that in the apparatus behind the scrubbers, in gas pipes, and also in dry coke scrubbers, flakes of salt are found, consisting of crystals of acid carbonate of ammonia. These facts establish the following rules for utilizing ammoniacal liquors produced in purifying the gas.

1- To employ the water collected *separately* from the hydraulic and the condenser, which frequently contains free ammonia capable of fixing at least half its volume of carbonic acid gas.

2. To keep the temperature of the scrubbers in which liquor is used and of the liquor itself, as low as possible, so as to absorb the greatest possible volume of carbonic acid (1 vol. NH_3 to 1 vol. CO_2) and produce the acid salt.

But even under the most favorable conditions,* it will only be possible, as remarked above, to remove from the gas one-fourth to one-fifth; or if neutral salt, as is usually the case, is formed, one eighth to one-tenth of the CO_2 and SH_2 by the ammonia contained in the gas at the same time.

It has been proposed to deprive the ammonia water of its sulphuretted hydrogen and carbonic acid by some means, and to pump the ammonia water, thus rendered caustic, over the scrubbers again for purifying.

Of course, any such removal of the sulphuretted hydrogen and carbonic acid from the gas liquor is only partial, but even if they were completely removed, the ammonia water produced must be regenerated at least three or four up to eight or ten times, to remove the whole of the carbonic acid, and of the sulphuretted hydrogen. In other words, ten times the quantity of ammonia water produced during distillation must be completely regenerated to effect the entire removal of the CO_2 and SH_2 from the gas.

If we reckon 15 cubic metres of gas to the cwt. of coal, and 5 litres of gas liquor, each cubic metre of gas would require at least 3 litres of perfectly regenerated gas water to pass the scrubber, or that simultaneously with the quantity of am-

* The author has not indicated the thermometric scale he uses, but it is, of course, the Centigrade.—Ed. J. G. L.

* Direct experiment proves that even passing a stream of carbonic acid through a solution in water of ammonic carbonate cooled down to 0° C., it is exceedingly difficult to obtain a solution of pure acid salt, only a large admixture of acid salt with neutral salt being produced. From this it would seem that the acid salt, when dissolved in water, is decomposed even at 0° C. Berthelot has observed a similar result in this sesqui-salt.

monia water produced along with the gas, one-third litre per cubic metre must be regenerated from three to ten times.

It is clear that the number of regenerations, and the quantity of ammonia water to be regenerated depend on the ammonia contained in it. With very weak liquor, if heat is required to effect regeneration, a disproportionately large bulk of water has to be heated also, which takes up nearly all the fuel heat and retards the eventual cooling. The water also impedes the absorption of the carbonic acid, while a concentrated solution of ammonia will absorb the carbonic acid quicker and more completely. It is, therefore, of the utmost importance, both from an economical and from a technical point of view, to reduce the number of regenerations, and the quantity of liquor to be regenerated to a minimum, by employing a concentrated gas liquor rich in ammonia. It follows from this that the ammoniacal liquor produced in gas making must not be used directly in the scrubber, but rather as a source of ammonia for the production of a concentrated purifying liquid—a strong ammonia water. The weak gas liquor may, when strengthened by that from the hydraulic and condenser, be used in the last scrubber, on account of the small quantity of free ammonia it contains; but the gas liquor obtained direct is to be kept carefully separated from that intended for purifying.

I consider this point, which, as far as I know, has never yet been so prominently brought forward, as most important; and I believe that the key to the whole process lies in the employment of *concentrated* ammonia water, so that it would be preferable to remove the sulphuretted hydrogen (which is always much less in quantity than the CO_2) also by wet purifying, and employ the dry oxide of iron purifier only to remove the last traces of SH_2.

It now remains to determine the maximum quantity of ammonia which the purifying liquor may contain.

Although it is desirable, in more than one respect, to employ in the scrubbers liquor in as concentrated a form as possible, there are certain limits which must not be exceeded.

The gas liquor may be considered as of suitable strength when, after repeated pumping over the scrubber, it has attained a maximum content of ammonia. A gas liquor (A) produced in a dry scrubber before the purifiers contained the following quantities:—

In One Litre of the Liquor.

NH_3
36.21 gr. = 47 46 litres.

CO_2 SH_2
39·2 gr. = 19·8 litres 14·8 gr. = 9·7 litres

$CO_2 + SH_2$
54·0 = 29·61 litre.

47·46 litres of ammonia, therefore, took up 29·6 litres $CO_2 + SH_2$, so that the gas liquor contained a considerable quantity of acid salt; the ammonia present had been in this case well used up.

From preliminary experiments it appears that in the process of regeneration known as Hills's process, about four-fifths of the carbonic acid contained in the gas liquor and three-fourths of the sulphuretted hydrogen are removed, one-fifth and one-fourth respectively of these gases (CO_2 or SH_2) remaining in the regenerated liquor. The quantities of these two gases expelled by regeneration can be reabsorbed by the ammonia water; that is to say, the regenerated ammonia water is capable of taking up at least three times the volume of carbonic acid and sulphuretted hydrogen that it still contains when used in the scrubbers.

If liquor of the above strength is used for purifying gas, the following proportions are established:—

Contents of the Liquor before Regeneration—in one Litre.

47·5 litres NH_3 and 29·6 litres $(CO_2 + SH_2)$.

After regeneration, with 10 per cent. loss of ammonia, which, though lost for purifying, may easily be recovered as a sulphate, and is replaced by using liquor of the proper strength in the scrubbers:

In one Litre of Liquor.

42·75 litres NH_3 and 7·4 litres $(CO_2 + SH_2)$.

Therefore 22·2 litres $CO_2 + SH_2$ have been removed.

These 7·4 litres $CO_2 + SH_2$ are combined in the ammonia water with 14·8 litres NH_3 as neutral salts. Therefore, 42·75—14·8, or, in round numbers, 28 litres NH_3, are free, and will fix at least 14 litres $CO_2 + SH_2$, or 1·4 per cent. per cubic metre of gas of these impurities.

One litre of ammonia water of the above-named strength will therefore remove 1·4 per cent. of $CO_2 + SH_2$ from each cubic metre of gas passing through the scrubber. This is on the assumption that the most thorough contact possible of the gas liquor with the current of gas is established by appropriate arrangements; further, that the gas enters the srrubber free from tar, so as to permit a uniform wetting, and also that the gas liquor is always pumped in an opposite direction to the stream of gas. And only the formation of neutral salt has been assumed, whereas, in fact, more carbonic acid can be absorbed, and acid salt formed, in proportion to the concentration of the solution. A daily production of 1000 cubic metres would, therefore, require one cubic metre of gas liquor to be pumped over the scrubbers, But, for continuous operation, an equal quantity of gas liquor must, during the same time, be regenerated, to supply the place of the first when saturated; therefore, 2 cubic metres of gas liquor of the above strength would be required for each 1000 cubic metres of gas.

The results are still more favorable if a stronger ammonia liquor can be used. According to a communication from Mr. Hunt to the British Association of Gas Managers at their meeting in 1876 (see *Journal of Gas Lighting*, vol. xxviii., p. 15) gas liquor was produced in the purifiers of 1·060 specific gravity, containing per litre 58 grains CO_2 and 8·9 grains SH_2.

Liquor of this strength may be employed again for purifying, after regeneration, without any further process.

The weights above given correspond to—

In one Litre of Liquor.

29·9 litres CO_2 and 5·9 litres SH_2.*

The gas liquor (B), therefore, contains in one litre 35·8 litre, $CO_2 + SH_2$.

After regeneration this liquor still contained, roundly, nine litres of both gases, so that 27 litres ($\frac{3}{4}$) had been removed, and this quantity can be again absorbed when passing through the scrubbers.

Each litre of this gas liquor will therefore absorb 27 litres $CO_2 + SH_2$, while A was only capable of absorbing 14 litres; the effect of B, therefore, is 1·9 times as great as A, apart from the greater energy manifested during absorption.

If, as in the preceding case, 1·4 per cent. of $CO_2 + SH_2$ is to be removed from the gas, every cubic metre of gas produced would require

$$\frac{1}{1{\cdot}93} = 0{\cdot}52 \text{ litre,}$$

or rather more than 0·5 cubic metre per 1000 cubic metres of gas, to pass over the scrubber, or 5-3rds as much ammonia water as is formed in producing this quantity of gas.

Under equal conditions, therefore, by employing gas liquor of the strength B, only half as much ammonia water would require to be regenerated, pumped over, or reserved, as with the strength A. The saving in fuel, labor, and plant is obvious.

For 1000 cubic metres of gas produced, and a content of 1·4 per cent. $(CO_2 + SH_2)$ in the gas entering the scrubber, or the removal of this amount from the gas, to work continuously rather more than one cubic metre of ammonia water of about 76 litres, or 58 gr. NH_3 per litre, is required. For a maximum production in 24 hours of one million cubic feet = 28,000 cubic metres, about 30 cubic metres of gas liquor of the above strength would be required; † one-half, or 15 cubic metres, must pass the scrubbers every 24 hours, the other half, with a reserve, being regenerated during the same time.

If only a portion of the gas impurities (sulphuretted hydrogen or carbonic acid) is intended to be removed, the carbonic acid will be chiefly absorbed, although a simultaneous absorption of sulphuretted hydrogen, in nearly the same proportion as the two gases exist in the gas liquor, cannot be avoided.

As each volume of sulphuretted hydrogen absorbed by the ammonia water prevents the absorption of an equal volume of carbonic acid, it will depend upon circumstances, and especially upon the relative proportions of the sulphuretted hydrogen and carbonic acid contained in the gas, how far the carbonic acid can be asborbed without a simultaneous removal of the sulphuretted hydrogen. The views formerly expressed by Patterson as to this proportion, therefore, require correction.—*London Journal of Gas-Lighting.*

* The content of ammonia cannot be ascertained from the information furnished; for it appears that Twaddel and ounces, if they mean anything else than specific gravity, refer to the ammonia ascertained by distillation and titration after being liberated by lime or potash. But for purification, only $(NH_4)_2$, CO_2, and $(NH_4)_2$ S come into question, not sulphocyanides of ammonium, &c.

† The contents of the gas liquor tanks at the Munich gas works are 204 cubic metres

Consumers Mutual Gas Company.

MEETING OF STOCKHOLDERS AND CHANGE OF DIRECTORS.

The first annual meeting of the stockholders of the Consumers' Mutual Gas Company of Baltimore was held yesterday morning at the company's office, No. 8 South street, Mr. B. F. Archer, of McNeals and Archer, New Jersey, the general contractor for the work, presided; H. E. Loane secretary. Some 44,155 shares of stock were represented, nominally valued at $10 a share. A new board of Directors was voted for, W. Mackay Laffan and F. B. Loney acting as tellers, and the following members were unanimously chosen: D. L. Bartlett, of Bartlett, Robbins & Co.; Jas. A. Gary, of Jas. S. Gary &; Chas. Reeder, of Chas. Reeder & Co.; J. W. Hall, of Hall Bros.; Bernard Cahn, of Cahn, Belt & Co.; Geo. Small, of Geo. Small, of Geo. Small & Co.; and H. E. Loane Contractor. The entire board is changed excepting Loane, who was also a member of the old board.

Mr. Loane, as secretary, read a report to the stockholders covering the operations of the year. The report stated the company was incorporated May 6, 1876, under the incorporation act of 1868. A special act had been obtained from the Legislature, but it was thought best to abandon it, as the question might arise that the Legislature had no right to pass a special act for a purpose for which the general act provides. They did not get to wark till November, and notwithstanding the delay since by unfavorable weather, 33 miles of pipe are laid, six miles are now on the street ready to be laid, the tank for the gasholder is finished, the holder and appurtenances one-half completed, and the remainder of the work is three-fifths completed. Nearly 8,000 consumers

have been secured, who have mostly contracted for a period of from two to five years for gas at $2 per 1,000. Already 2,300 services have been put into houses. It was stated that they expect to be able to furnish gas in September next. The Lowe process will be used, by which oil is substituted for coal in the manufacture of gas, and it is proposed to furnish an 18-candle light. The company has given employment to several hundred men.—*Baltimore Sun, July 10th.*

Electric Fall Machines.

These are for demonstrating the laws of falling bodies. In one arrangement a brass ball is hung by a thread some height above the ground. Under it, at a distance=1, are two metallic balls connected with the poles of an electric machine; they are so far apart a spark cannot pass between them, but if the suspended ball drop between them a spark will pass. Further down, at distance=4, then=9, etc., are similar pairs of balls. The thread of the suspended ball being burnt, the latter falls between the successive pairs, giving passage at each pair to the current, and simultaneously the spark in another part of the circuit strikes a revolving soot-blackened drum, making a mark. The distances between successive marks are found to be equal. In a second arrangement there are two cylindrical conductors, insulated and vertical, with a metallic ball suspended between them at the top, hardly filling the interval, and sufficient to enable a spark to pass between the cylinders, which are connected with the poles of an induction (secondary) coil. One of the cylinders has a coating of soot-blackened paper. The thread is burnt and the ball falls; sparks are made to pass at regular intervals of time, by means of clockwork, interrupting the battery current. Each spark leaves its mark on the blackened surface; and thus are shown the spaces passed over in equal times.—M. Waldner.—*Sci. Amer.*

West of Scotland Association of Gas Managers.

The Fifth Yearly Meeting of this Association was held in the Council Chambers, Linlithgow, on Thursday, April 26—Mr. Levi Monk (Lanark), President of the Association, in the chair.

Mr. James M'Gilchrist (secretary) read the minutes of last meeting, and of several committee meetings which had been held during the past six months, and these, on the motion of Mr. Mitchell (Coatbridge), seconded by Mr. Scott (Musselburgh), were unanimously adopted.

PRESIDENT'S VALEDICTORY ADDRESS.

The President then delivered a valedictory address. In his opening remarks he alluded to the operations of the benevolent-fund, the increase in the number of members of the Association, and the changes of location by members during the past year. He then referred to the recommendation made to the British Association for the Advancement of Science to form a "Special Gas Section," stating that it did not originate in a desire to break up or in any way interfere with the various associations of gas managers, but to enlist the co-operation of gentlemen having time, ability, energy, and wealth at their disposal, in the study of existing arrangements for the manufacture, distribution, and consumption of gas, with a view to suggest and recommend improvements which might with confidence be adopted by gas managers, and worked out in a practical form. He mentioned that a report would presently be brought up by a sub-committee, embodying the result of their investigation of Messrs. Aitken and Young's process, which had been for twelve months in operation at the Hamilton works, and he expressed his own opinion that that process secured the perfection of condensation of illuminating gas, with the addition of a good scrubber or washer. He had no doubt that other modes could be provided than the employment of steam for keeping up the temperature, where steam was not available, so that in small works especially, the process could be used with much advantage. Having mentioned the titles of the papers which would be submitted for discussion, the President alluded to the "claptrap" on the subject of gas supply, which was to be found from time to time in the newspapers, remarking that it would be very amusing if it were not for the discontent it cherished in the public mind, and the annoyance it caused to gas managers. The extended use of gas for cooking and heating purposes seemed to him to be a good reason for endeavouring to adopt as a general standard 20-candle gas, and he was not prepared to agree with the writer of a long and ably written article in the *Dundee Advertiser*, who advocated a reduction to 16 candles. He believed that with a condenser such as would be reported on by the committee, there would be no difficulty in maintaining a 20-candle standard for an unlimited period. Even supposing all first-class coal to be exhausted, there was, as he was credibly informed, an abundant supply of splint and caking gas coals, inferior cannels, and rich shales in Scotland (if only such a price could be obtained as would pay to work them) sufficient to maintain a standard of 20-candle gas for centuries to come. Such being the case, the Scottish people should not accept a lower standard. For many reasons known to most of the members present, it was very evident that burners suitable for lighting, cooking, and heating with 20-candle gas were not suitable either for 14 to 16-candle gas on the one hand, or 24 to 32-candle gas on the other, and it was equally certain that manufacturers had much difficulty in providing proper means of combustion for such varied qualities. The President then referred to the recent exhibition of gas apparatus at South Shields, expressing his regret at not having been able to accept an invitation to be present on that occasion. In the name of the Association, he thanked Mr. Warner for sending to this meeting a specimen of his market gas standpipe for inspection, and on their behalf also he wished every success to their youngest born brother, "The North of England Gas Managers Association." The President then briefly passed in review many of the subjects which have, during the past year, been brought forward in the columns of the *Journal of Gas Lighting*. He alluded to the working of the Burghs (Scotland) Gas Act, and the introduction of auction clauses, by Standing Order, into gas bills, and, in conclusion, referred to the arrangements made for the entertainment of the members in connexion with this meeting.

ELECTION OF OFFICE-BEARERS.

Mr. Fairweather (Barrhead) next moved that the following gentlemen be elected office-bearers for the ensuing year:—

President—Mr. James M'Gilchrist, Dumbarton.
Vice-President—Mr. Duncan Jeffrey, Kirkintilloch.
Treasurer—Mr. W. Smith, Helensburgh.
Secretary—Mr. R. S. Carlow, Port Glasgow.

THE AITKEN AND YOUNG PROCESS.

Mr. M'Gilchrist then read the report of the sub-committee on Aitken and Young's patent, as follows:

At a meeting of the committee, held at Glasgow on the 7th day of August, 1876, a sub-committee was appointed, consisting of the following gentlemen:—Mr. Wm. Smith, Helensburgh; Mr. Jas. M'Gilchrist, Dumbarton; Mr R. S. Carlow, Port Glasgow; and Mr. L. Monk, Lanark (convener), to investigate into the practical working of the Aitken and Young patent condensing process at Hamilton Gas-Works. It was also suggested that the sub-committee should endeavour to secure the practical and scientific assistance of their honorary member, Mr. Stewart, of Greenock. On application being made to that gentleman, he at once kindly agreed, if his spare time should admit, to give them all the assistance in his power.

A preliminary meeting of the sub-committee was held at Dumbarton, on the 29th day of August, 1876, at which Mr. Stewart was also present, when it was considered expedient that, before entering upon the regular trials, it would be advisable to visit the Hamilton works, and make themselves conversant with the whole arrangement, and also make such alterations and additions as would be necessary to have the trials made in the manner desired by them. In accordance with this resolution, the sub-committee, along with Mr. Stewart, visited the Hamilton works on the 5th day of September, 1876, and made a preliminary inspection of the whole arrangement, which consisted of the following plant:—The retorts are of fire-clay of the ordinary D-shape, 26 inches by 15 inches by 7 feet 8 inches long, set three in an oven, the whole bench consisting of 27 retorts, 12 of which were in use at the date of the visit. The hydraulic main is D-shaped, 18 inches by 18 inches, placed on pillars alongside of the front wall. The stand-pipes are carried overhead to the hydraulic, and some of the stand-pipes (*i. e.* from top of ascension-pipe to hydraulic) were covered with some non-conducting composition. The outlet from hydraulic main, 10 inches diameter, passes across the retort-house, 30 feet, and along the wall of purifying-house, 40 feet, to condensers, which are of the ordinary vertical pipe description, the pipes twelve inches diameter, and placed at the back of the retort-house, as is also the new analyzing condensing arrangement. This arrangement is similar in construction to the model shown at our Glasgow and Greenock meetings, and which is here again for the inspection of those members who had not the opportunity of seeing it before. The pipes leading from the hydraulic, and into the condensers and scrubbers, are connected by branch pipes in such a manner that, by means of slide-valves, either the analyzing condensing or the ordinary condensing apparatus may be thrown into use. At the desire of the sub-committee this was done to show the working, when they were much surprised with the difference in the character of the gases condensed by the two processes. When the ordinary process was thrown into action, the gases, as they issued from a ¾-inch stop-cock placed on the inlet to the scrubber, had a brown, smoky appearance, and when allowed to blow on a piece of paper, gave a black, tarry stain. On the other hand, when the analyzing condensing arrangement was thrown into action, the issuing gases were comparatively colorless, and gave only a slight brown stain to paper, which rapidly dried up on exposure to the air.

As already stated, the gases pass from either of the condensing arrangements to the ordinary square perforated plate scrubber, and where the analyzing condensing arrangement is in use, the mixed tars and weak liquors are run from the bottom of the analyzer into the cooling tank, where they are cooled and separated, the weak liquor being pumped into the scrubber, and the tars run off to the tar-well. From the scrubber the gases pass to the exhauster, which is of the kind known as "Andersons;" thence to four purifiers, lime being the sole purifying agent employed. The station-meter is very small for the quantity of gas it has to register, but the sub-committee considered that, as the tests were to be *comparative*, and the measure of the gas made with the same instrument, any error made would affect both the processes alike. The gas-holders are three in number, the one nearest the testing-station having a capacity of 36,000 cubic feet. From the manner in which it was connected with the mains leading to the town and inlet-main from works, it was selected by the sub-committee as the one best suited to be connected to the testing apparatus in the laboratory to be employed during the trials. At the request of the sub-committee, a ¾-inch pipe was carried from the inlet of the gas-holder into the testing-room, that experiments might be made with the gas just as it was newly made, and also after having been stored for some time; and, further, to test the gas after being passed through a long length of main underground, a testing-station was prepared about 2000 yards from the works. The testing apparatus at both stations were as far as possible duplicates of each other, and the same candles and burner were used at both stations.

The nature of the processes to be tested necessitated that the same gas-producing material should be used for a considerable time, and, as the season was

far advanced, and the consumption great, and also as the capacity of the works was not sufficient to make and store two qualities of gas, it was seen by the sub-committee to be impossible to use a coal giving any other than a gas somewhat near what the consumers had been receiving. They, therefore, decided just to employ the usual materials used in the works for the trials. This was a mixture of Camp parrot and Westwood shale.

After having made these preliminary arrangements, the sub-committee again met at Hamilton Gas Works on the 20th of October, 1876: Mr. Monk having visited and remained over from the previous day, to see that the same descriptions of coal and shale were used, and that the analyzer should contain only tars and naphthas resulting from such proportions of shale and coal as were to be used in the trials. After a careful testing, with 36 hours working of each process, the following average results were obtained:

TABLE No. 1.

Average Results of Preliminary Experimental Tests made for 36 hours, to test the Aitken and Young Condensing Process at the Hamilton Corporation Gas Works, by a Sub-Committee of the West of Scotland Association of Gas Managers. Table corrected for Temperature to 60° Fahr., and for Barometrical Pressure to 30 inches.

Test No. 1.	No. of Retorts working.	Camp Parrot Coal used. Cwt.	Westwood Shale used. Cwt.	Total Cwt.	Index of Meter. Commencing.	Index of Meter. Ending.	Gas Made. Feet.	Gas per Ton of Mixture.	Durability of 5-in Flame. Min.	Durability of 5-in Flame. Sec.	Condensation by Bromine.	Illuminating Power. Stand. Candle.	Specific Gravity of Ammoniacal Liquor. From Analyzer or Condenser.	Specific Gravity of Ammoniacal Liquor. From Scrubber.	Specific Gravity of Tars. (Water 1000.)	Pr. Centage of Naphtha when Tars distilled to a Temperature of 320° Fahr.	Pounds of Sperm per ton.
Analysing Process—																	
Oct. 20, 1876, 3 p.m., to Oct. 22, 3 a.m.	15	263½	40½	310	5,995,750	6,127,250	131,500	8483	59	00	9.50	28.26	Twad. 1.5	Twad. 6.0	1158	Traces.	821.64
Ordinary Process—																	
Oct. 22, 1876, 3 a.m., to Oct. 23, 3 p.m.	15	289	44	333	6,127,250	6,267,000	139,750	8393	52	00	8.50	21.96	3.0	4.0	1146	2.00	631.92
Difference for or against analyzing process								+90	+7	00	+1.00	+6.30	—1.5	+2.0	+12	—2.00	+189.72

The temperature of the tars in the hydraulic ranged during the experiments from 180° to 190° Fahr., and the temperature of the tars as they issued from the analyzer ranged from 220° to 230° Fahr.

The results obtained from testing the gas as it was newly manufactured, after it had stood for twelve hours in the gas-holder, and after it had travelled to the distant testing-station, were substantially the same by both methods of manufacture (*i. e.*, for permanency of hydrocarbons), no material deterioration of the illuminating power having taken place in either gas.

As indicated by the above table, samples of the tars from either process showed, on being carefully distilled, that the analyzer tar contained about 2 per cent. less naphtha than the ordinary tar. The ammoniacal liquor, as it flowed from the analyzer, had a specific gravity of only 1½° Twaddel, and had a very feeble smell of ammonia, but, after it was cooled and passed through the scrubber, it acquired a specific gravity of 6° Twaddel. The ammoniacal liquor, as it flowed from the ordinary condensers, had a specific gravity of 3° Twaddel; that from the scrubber, 4° Twaddel. By the ordinary process, water was in part used in the scrubber.

An examination of the gases, as they entered the purifiers, showed that the gases from the analyzer process were almost perfectly denuded of suspended tarry matter—indeed, they were almost colorless—whereas, the gases condensed by the ordinary method had a slight smoky appearance, and contained a considerable quantity of suspended tarry matter.

The quantities of gaseous impurities, sulphuretted hydrogen, and carbonic acid, as ascertained (comparatively from a number of experiments, by using a "Cooper's tube," and employing acetate of lead and caustic potash as absorbents, showed a decided advantage in favor of the analyzer process. We believe this to result from the more perfect action of the cooled water from the analyzer absorbing the ammonia in combination with the gaseous impurities, or as the salts, carbonate, and hydrosulphate of ammonia. The time over which the experiments extended was far too short to make any practical test as to the relative quantity of lime used to purify the gases resulting from the different methods of condensation; but, looking to the freeness of the analyzed gas from suspended tarry matters, and the comparatively smaller quantity of gaseous impurities, the sub-committee are of opinion that there will be a very considerable saving in the lime employed for purification.

So soon as these experiments had been corrected and drawn up in the form of an interim report, they were placed before the committee at a meeting held in Glasgow. It was proposed to have these reports published for the benefit of the Association; but Mr. Young, who was present, asked as a favor that the committee would defer publishing their report until it had either been verified or disproved, because he considered the results considerably too high, and much better than he had ever got whilst experimenting with the process on a comparatively small scale. This the committee at once granted, seeing that their sub-committee proposed making experiment for permanency of hydrocarbons during the winter, and a final trial similar to the one just made, early in the spring, in order to have the report drawn up for this meeting. The limited time at the disposal of the sub committee prevented them from making the proposed experiments during the cold whether in winter; but they again met at Hamilton on the 12th of March, when fortunately there was a severe frost, snow, and wintry weather as at any time during the winter.

The sub committee commenced by making a trial extending over 42 hours, with a mixture of eight of Camp parrot coal and one of Westwood shale, that being the mixture which had been employed for some days prior to the visit of the sub-committee. The following table gives the average result of the testings:

TABLE No. 2.

Average Results of Final Experiments made to test the Aitken and Young Condensing Process at the Hamilton Corporation Gas Works, by a Sub-Committee of the West of Scotland Association of Gas Managers. Table corrected for Temperature to 60° Fahr., and for Barometrical Pressure to 30 inches.

Tests.	No. of Retorts working.	Camp Parrot Coal used. Cwt.	Westwood Shale used. Cwt.	Total Cwts.	Index of Meter. Commencing.	Index of Meter. Ending.	Gas Made. Feet.	Gas per Ton of Mixture.	Durability of 5-in. Flame. Min.	Durability of 5-in. Flame. Sec.	Condensation by Bromine.	Illuminating Power. Stand. Candle.	Specific Gravity of Ammoniacal Liquor. From Analyzer or Condenser.	Specific Gravity of Ammoniacal Liquor. From Scrubbar.	Specific Gravity of Tars. (Water, 1000.)	Pr. Centage of Naphtha when Tars distilled to a Temperature of 320° Fahr.	Pounds of Sperm per ton.
No. 2 Test (42 hours). Analyzing Process— March 12, 1877, 12 p.m., to March 14, 6 p.m.	15	286	36	322	862,910	1,003,500	140,590	8732	53	22	9·13	26·47	...	...	...	...	...
No. 3 Test (48 hours) Analyzing Process— March 14, 1877, 6 p.m., to March 16, 6 p.m.	15	288	72	360	995,500	1,151,900	156,400	8688	53	24	9·50	27·54	Twad. 2·5	Twad. 5·5	1162	0·50	820·35
Ordinary Process— March 19, 1877, 6 p.m., to March 21, 6 p.m.	15	288	72	360	1,372,300	1,530,300	158,000	8777	49	02	8·80	23·30	3·0	4·5	1154	2·62	701·15
Difference for or against analyzing process								—89	+4	22	+70	+4·24	—·5	+1·0	+8	—2·12	+119·20

As in October last, during the time the trials were being made with the ordinary process, numerous complaints were made by the consumers throughout the town about the low illuminating power, it was suggested by Mr. M'Gilchrist, and agreed to by Mr. Dunlop and the sub-committee, to use a rich mixture of gas making materials, so that the consumers could not have such cause of complaint; and it was decided to use a mixture of one part of Westwood shale to four of Camp parrot coal.

The final trial of the analyzer condensing process commenced on Wednesday, March 14, at 6 p. m., and continued till March 16, at 6 p. m. The analyzing process was continued in use over the Saturday, but it was thrown out of use on the Sabbath, and the ordinary condenser brought into action. The sub-committee again met on Monday, and commenced a trial by the ordinary process at 6 p. m., and continued for 48 hours, till 6 p. m., on Wednesday evening.

During the final trials, the results of which are recorded in the above table, much higher heats were employed than in the first trials, and smaller charges put into retorts. This, as shown by the table, has resulted in a considerably increased yield of gas, and by the ordinary process a slight increased gross sperm value over the previous experiments, but as the high heats would leave a smaller quantity of naphthas undecomposed, the analyzing condensing process, although giving a very substantial increase in the gross sperm value, does not show an increase in proportion to the shale used. This proves that beyond a certain temperature it becomes unprofitable to carbonize coal for a high illuminating power, and that in order to carbonize coal economically it is essential to employ such a temperature as shall produce the proper proportion of gases and volatile hydrocarbons to carburet those gases. Another cause for the low illuminating power of the gas being produced at this time was the comparatively lower atmospheric temperature (from 15° to 20° Fahr.) compared with that when the previous experiments were made. Or it may be that as during the first trials the fifteen retorts employed were all placed together, and at the end nearest to the outlet from the hydraulic to the condenser, and the temperature of the gas kept up to 180° or 190° Fahr. in the hydraulic and 220° to 230° Fahr in the analyzer, and during the final experiments the retorts worked were at each end of the hydraulic, and, consequently, the whole length of the hydraulic was cooling the gases produced from the retorts at the end farthest from the outlet, the consequence being that the gases in the hydraulic were only 160° to 170° Fahr., and the gases and tar in the analyzer 214° to 224° Fahr., this lowness in the temperature is the most probable cause, as in the latter experiments 0·9 per cent. of naphtha was left in the analyzer tar, whereas in the former experiments there were only traces of naphtha left.

As in the case of purification, the time over which the trials extended was too limited to ascertain the exact quantities of tars produced to each process, as the trays of the analyzer are always left full, but it may be approximately stated at about eighteen gallons of tar per ton of the mixture of coal and shale employed; and as all that the analyzer does to the tar is simply to separate the naphthas and diffuse them through the gas, the analyzed tars will amount to the eighteen gallons, *minus* the naphthas diffused through the gas. This, as shown by the table, amounts to respectively 2 and 2·12 per cent., or equal to about one-third of a gallon per ton of the gas material employed. This would indicate that about 2¾ grains weight of naphtha were diffused through each foot of gas made by the analyzing process, and that a little over 1-3rd of a gallon of naphtha diffused through the gas from a ton of mixture gave an increase of sperm equal, in the first trial, to 189·72 lbs., and in the latter trial to 119·20 lbs. respectively, per ton of mixture distilled.

In concluding this report, the sub-committee would add that it is obvious that the net gain of working this process will be affected by many circumstances which can easily be worked out by practical minds. The chief recommendation in working this patent process evidently is the fact that an expensive first-class coal in large quantities is not required to produce a gas of high illuminating power; and further, that the only expense or trouble connected therewith is the providing of steam to keep up the temperature in the analyzer. The sub-committee desire to tender their very best thanks to Mr. Dunlop for the very courteous and hospitable manner in which he entertained them while the experiments were being made in Hamilton, and for the promptitude with which he acceded to their requests in every way; and they desire to add that it reflects the greatest credit upon his committee and himself in acknowledging the value of the patent, and in getting apparatus erected so soon after it was brought under the notice of the Association.

(Signed) William Smith, Helensburgh.
Jas. M'Gilchrist, Dumbarton.
S. Stewart, Greenock.
Robt. S. Carlow, Port Glasgow.
L. Monk (Convener), Lanark.

After the reading of the report on the Aitkin and Young process,

Mr. Dunlop said: Gentlemen, the report which has just been read to you on this new process of Messrs. Aitkin and Young is so full and complete that it leaves me, indeed, very little to say. At the outset I may incidentally mention that, for my own personal satisfaction, I took tests immediately after those taken by your committee, and my results correspond exactly with those which have just been submitted to you. However, as has been stated in that report, there are certain things connected with this new process which can only be satisfactorily tested by trials extended over considerable periods of time; as, for instance, as to whether the prolonged heat to which the tars are subjected has a tendency to cause them to pitchify, or be deposited as a char on the heated surfaces to which they are exposed; the relative quantity and quality of the tar and ammoniacal liquor from the old and this new process; the relative purity of the gases from each process, with the quantity of purifying material required, and as to whether the hydrocarbons suspended by this new process are permanently suspended in the gases and conveyed to the consumers, or whether they are in part deposited. I think the best way for me to place this matter before you is just to give you a note of my experience of the process since it was introduced into the works at Hamilton. First, then, gentlemen, so far as my experience has gone, I am perfectly satisfied that the high heat to which the tars are subjected—from 212° to 224° Fahr.—has no other effect upon them, than to prevent them absorbing illuminants from the gas, and to distil from them the naphthas which they may have absorbed before reaching the analyzer. My reason for believing this will be gathered from the following facts. The bottom casing of the analyzer, from the time it was fitted up, was never perfectly tight, but as it was expected it would take up after working for some time, it was kept at work for upwards of three months; at the end of that time, seeing it was hopeless to expect it ever to be tight, I had it thrown out of action for repairs. I then carefully examined the contents of each tray and the surfaces of the heated casing-plates, and found the plates were as clean as the day they were erected, not a single particle of scale or pitch being upon them. The three lower trays contained tar, and each successive tray contained lighter and lighter tars, till, on reaching the two uppermost, only naphtha was found. With reference to the quantity of tar, I regret to say I cannot speak very definitely, as during the period prior to the introduction of the analyzer the tar and ammoniacal liquor were sold in a mixed state, and, therefore, I am unable to state the quantities of tar and ammoniacal liquor per ton distilled; but on comparing the gross quantities produced from both processes, I find a considerable gain is shown from the new process. This at first sight may appear strange; but it is easily accounted for by the fact that the analyzer removes nearly every trace of tar, and prepares the gas to be more perfectly acted upon by the denuded water from the analyzer; whereas, when the old process was employed, a very considerable quantity of suspended tarry matter was carried forward to the first purifier, and, getting deposited on the lime, was thereby lost. Of course, there is this material difference between the tars I formerly produced and those I have now, the latter being thick, syrupy, containing little or no naphtha, and have just the appearance of what is known as boiled tar. As to what may be the relative value of the tars from the old and new processes, it would take a longer experience and a more extended application of the new process before the tars would find their level; but, from inquiries I have made, and from offers received for the boiled tar, I am satisfied that a price could be got quite equal to that received for ordinary tar. There is this further advantage in the analyzer process that a much stronger ammoniacal liquor can be obtained, as the gases, being prevented from giving up their ammonia in the analyzer, enter the bottom of the scrubber in a condition capable of giving a strong liquor. I have next to refer to the amount of lime required by this process. In respect of purifying plant, the Hamilton works are rather badly placed. There are only four purifiers, eight feet square, to pass nearly 140,000 cubic feet of gas in 24 hours, necessitating in mid-winter the changing of two purifiers daily, and further, as both the coal and shale give off a very considerable quantity of CO_2 and HS_2, the lime account is rather high. The make of gas also increased very rapidly during the twelve months ending April last. The make for the year 1876 was over 22 million cubic feet, while for the year ending April, 1877, it was upwards of 25 millions. The increase having taken place principally during the winter months, burdening the already deficient purifying power to a greater extent, one would have expected it would have necessitated an increased quantity of lime per 1000 feet of gas purified. On looking over my books, however, I find this not to have been the case, as from the superior manner in which the gases have been prepared for purification by the analyzer process, although the make was three millions more than last year, nearly the same quantity of lime has been used, viz., for the year ending April, 1876, 170½ tons; and for the year ending April, 1877, 172 tons, showing a saving of 12 per cent. This now brings me to speak of the permanency of the naphthas which have been diffused through our gas. And I believe, had we only made the same quantity of gas this year that we did last, we should have saved upward of 20 per cent. of our lime. I am fully satisfied, from experiments I have made at the works, and at the distant testing-station, that our gas is just as permanent as, if not more so than when made by the ordinary process. The only difference which I can detect between the old and this new process is, that what little naphthas we have to pump from our gasholder drip-boxes are neither so great nor so heavy, or dark and tarry, but are quite pale and transparent; and I believe this small quantity of hydrocarbon liquid falling from the gas to be due to the water accompanying it in a solvent manner, causing it to deposit. I may also state that for a short time I made a series of experiments with the hydrocarbon or water-gas process, by fitting up one of my ovens in the manner explained by Mr. Young at our Greenock meeting last year. The results showed that a very large yield of gas could be got per ton of bituminous coal distilled, but that it would not pay to employ this process when coal could be got as cheap as at Hamilton. The gas was perfectly regular in quality, and I believe, when coal is high priced, the water-gas process could be practically wrought by the analyzor condensing arrangement, and to a substantial profit. I have no doubt that many of you will be surprised at the great gain in illuminating power resulting from the small quantity of naphtha vapors added to the gas. I confess, at first, I could hardly believe it possible; but experience and experiment soon convinced me that it was substantially true. Had time permitted, I should like to have given you the results of those experiments—perhaps at some other time I may be permitted to do this; in the meantime I may briefly state that I believe the cause to be due to the greater density of the naphtha vapors, and the high per centage of carbon in their constitution. I will close by reading an extract from a paper read by Prof. W. Dittmar, at the meeting of the British Association in Glasgow last year, showing the wonderful difference in the amoun of light given by adding different hydrocarbons to hydrogen, the only difference being that the carbon in

the one was in a much more condensed state than in the other. (See *Journal of Gas-Lighting*, volume xxiii, p. 669.

Mr. Peebles—I beg to state that I think the labors of this committee deserve our very best commendations. What I observe in connexion with this report is the great honesty of purpose that seems to pervade the whole of it. The experiments have been gone into in the most intelligible way, and with a direct aim at truth. There is no mystery whatever to be seen in connection with it. I have had something to do with inquiries of this sort, and I must say there was always some little thing that was under the rose which could not be got at—something that was hardly ready to be seen, and that, if we would wait a little longer it would all be made clear. I remember visiting East Barnet, when Dr. Eveleigh's process was going on. At that time it was involved in a good deal of mystery, and I think that any one who takes up Dr. Eveleigh's process will see that the Doctor's imagination went a long way. At last, however, the bubble burst, and the poor unfortunate shareholders came to a bad end. With this process it is different because we see one of its projectors objecting to the results brought out by people appointed to conduct the experiments, on the ground that these experiments were of too satisfactory a description. Instead of making the best use he could of this report, he would not be satisfied until the experiments were gone over again. That speaks volumes not only for the honesty of purpose of inventors, but also for the method which the committee adopted in conducting these experiments. I have always thought, since first I heard of this process, that it would be remarkably efficient, and ultimately, I have no doubt, it will turn out to be all that is expected. I am pleased to have had such an intelligible account of it, and I think this investigation should form a precedent for future investigations—that there should be an entire absence of the mysterious. Everything should be fair and above-board, and every facility should be given by gas managers for everything being seen. This has been the case here, and I think Mr. Dunlop deserves our best thanks for the facilities he has given to the committee to see and to go so thoroughly into this matter.

Mr. Stewart (Greenock): The committee did me the honor to ask me to assist in this matter, and I would like to say a word or two. Between the first and the second table there is a considerable difference in the amount of the sperm value, and that may lead to some questions. I think, however, I should say that everything was done in a most careful manner, notwithstanding the difference arrived at. Perhaps it would be well if Mr. Young would point out the reasons which occur to him accounting for that difference, because if that table should go before the public without an explanation accompanying it, an erroneous impression might be formed in regard to the value of the invention. I would also have liked to have tried some experiments with second class coals by themselves, as it would have been interesting to see the results arrived at. I have no doubt, however, but that there would be considerable increase in the sperm value per ton of coal, or, in other words, increased average illuminating power. Further, I would suggest whether it would not be an advantage, in case of works making a large quantity of gas, to have two or more analyzers, so that in summer time, when the make of gas is small, one analyzer only need be used, to avoid the risk of making the tar pitchy, which there would be a probability of if the whole analyzer power were employed as during the time of maximum make. I should like that some persons would ask questions, so that the whole process may be discussed. I may say that the experiments were openly and fairly conducted, and if explanations are wanted, now is the time, so that there may be no after-talk or disappointment.

Mr. Young: I rise with great pleasure indeed to make all the explanations within my power in regard to the trials made at the Hamilton Gas-Works. In the first place, I may be allowed to explain that preliminary trials, to ascertain whether or not there was anything in the process, were first conducted at Causewayhead, where there were small works erected for the purpose of testing the material made by the Mackenzie process. We altered these works so that we could roughly test this process, and we found considerable gain. But as I could not very well devote my time to conduct the experiments at Causewayhead, at the desire of Mr. Aitken I erected a small experimental apparatus at the works at Clippens. Of course, I am quite aware that results got from a small experimental apparatus are not to be depended on, but they give comparative results. The average result of these experiments was a gain of something like 15 per cent. in the illuminating power. In all cases we had a gain, sometimes greater and sometimes less, dependent upon the nature of the coal, but invariably the gain was greater where mixtures of rich and poor, or common, coals were employed. Mr. Mitchell, now of Coatbridge, was my assistant during these experiments, and he can substantiate my statements. When the experiments were entered into at Hamilton, I made it a point to stay away, and to leave the committee unbiased in their judgement. They experimented and obtained results, and submitted those results to a meeting of the committee, at which I was present. After hearing the report, I rather thought that there had been a mistake—that an error had crept in somewhere, as the results were higher than I had got, and higher than I expected them to be, and, I believe, were above what the average of results will be; but, at the same time, I am satisfied that the results brought out by the second table will be obtained. Midway between the two tables, perhaps, will be something like what is to be got by working third-class parrot coal with shale. I have thought over the matter, and the only way in which I can account for the extra high results you will notice in the first experiments, is that heavier charges were used in the retorts, and that a smaller yield of gas per ton was produced, and consequently the likelihood of greater production of naphthas. Further, the temperature of the surrounding atmosphere was higher, which would enable the gases to hold in diffusion a greater quantity of those naphtha vapors so produced; for, as you all know, even when the ordinary process is employed the gases during the warm weather are always richer from a given quality of coal than from the same coal during the winter months. Indeed, the gases will take up during the warmer months of summer the volatile hydrocarbons which may have been condensed and deposited in the gasholder, &c., during the winter months. On the other hand, during the latter experiments the charges employed were much lighter, and the heats higher; consequently, as shown by the table, there was produced a larger volume of gases, and also there would be, for the same reason, a smaller quantity of undecomposed naphthas. Further, during these latter experiments, the weather was very much colder, to the amount of some 15 or 20 degrees; therefore the gas would be unable to take up and hold in diffusion such a large volume of naphtha vapors. The difference in the quantities of naphthas is not indicated by the table, but this may be from the fact that it is difficult to get a fair average sample of the tars from this new analyzing process, because the whole of the trays of the analyzer are filled with tars varying in character, the bottom trays containing tars nearly entirely denuded of naphthas, and resembling what is known as boiled tars: the upper trays, on the other hand, containing pure naphthas, the whole amounting to something like four or five tons. It will, therefore, be quite evident that, before a fair average sample of the tars could be got, it would be necessary to work the process for such a length of time as would completely fill the whole of the trays of the analyzer. There was also a longer period of time between the second set of experiments, and, as already explained, it requires this process to be worked a considerable time before accurate results can be got, in consequence of the washer, &c., being charged with naphthas, which would be taken up by the ordinary gases were the ordinary process immediately to succeed that of this new analyzing process. I therefore think that the second set of experiments are more to be relied upon than the first. Perhaps, as I have already said, if you strike a mean between these two tables, you will arrive at what would be the actual results from this new process. There is one other result in the table on which I would like to make a few remark—that is, though the low illuminating power of the gas produced by the ordinary process of a mixture of Camp parrot and shale there indicated should have given a gas of something like 25 candle illuminating power, yet, as indicated by the table, the result by the ordinary process is only 23·30. I am satisfied this is easily accounted for by the burner. To make certain that it was the same burner which was used through the whole of the experiments, it was marked. At the conclusion of the experiments I had that burner tested, and I found that it gave results very much inferior to a first class burner. However, our results here are only comparative; but we are certain they are relative, because they were all done with the same burner and the same candle. That is the explanation I have to make, and if there are any further questions to be asked, or information I can give, I will be most happy to give it. We are most anxious to get this process thoroughly tested, because, if it is "humbug," as Mr. Brodie characterizes certain things, it will fall to the ground; but if there is anything in it, I am sure it will fight its own way.

Mr. Mitchell: I have spent many valuable hours with Mr. Young in experimenting with this and other processes. From the table shown there is a great saving effected on the two processes. The experiments at which I assisted were mostly with the water gas, and the results with the analyzer process were marvelous. So much am I convinced of the advantage to be derived from this process, that in laying down the ground plan for new works at Coatbridge, I have made arrangements to have the analyzer erected.

Mr. Hall (Berwick): I think it would have been much better if the coals had been kept equal, because the difference in illuminating power might arise from the mixture. Shale, as those who have experience in working it know, has a greater illuminating power than splint. An analysis of each of these coals might have been giving in the tables, as stated by some analytical chemist, showing the difference between the illuminating power of the coals as received from the pits, and the results by the analyzer, and then we could have seen the difference.

Mr. Stewart: The per centages of coal are precisely the same, although the quantities are different.

Mr. Young: I may be permitted to mention this, further, that the figures in the tables are founded not on results made with coal worked for the purpose of giving the best analytical results. We all know that the analysis of coal which is supplied to us is, as a rule, not the actual yield got in practical working. What we have tabulated here are the actual results obtained by the commercial working of the coal in the same retorts, passing through the same scrubber, the same purifier, the same meter, and stored in the same gasholder; the same photometer, the same candle, and the same instruments were employed in ascertaining the illuminating power—the only difference being the modes of condensation; so that we have exact comparative results of the coal. We all know that shales and coals are variable far more than the difference in the per centage of results given by the tables; but the coals and shales were in the works in bulk, and the tables now show the comparative results of the actual work, and not what might have been obtained in a laboratory experiment. There were 15 retorts employed, and they worked 36 hours on the one occasion, and 48 hours on the second occasion.

Mr. Scott (Musselburgh): I have no doubt the process is a good one. What we want to do in distilling the coal is to make the gas serve the public, and make as much profit to the companies as we can. I believe that that process and another process which has been in operation, if thoroughly carried out, would be the means of enabling gas companies or corporations to

meet the high demand of later years for wages and the increased price of coal. What I would like to know is, whether this process demands more care on the part of the workmen, and does it compensate for the new apparatus which requires to be introduced? I should like also to know whether it involves additional duties to the superintendent. I have had a process working for some time, and I am perfectly convinced that it is a profitable process if it is accurately carried out; but with my process I have experienced some difficulty in doing this. I had not only to teach the men to work this process, but I had also to unlearn them the process they had previously been accustomed to. This I experienced some difficulty in doing; but to satisfy myself as to its value, old as I am, I have stood 36 hours at a stretch. I may state this process has entailed considerable extra care upon me, and I am not so able for it now as I once was; but I am sure, if in the hands of a young energetic man, it would become a success. Now, I want to know, can this new process be conducted easily, and to the same advantage?

Mr. Dunlop: I may say I have never had any trouble in attending to the analyzer since it was introduced. The steam is turned on at the analyzer by an ordinary steam stopcock, and it has not been touched for months. The temperature applied to the tars in the analyzer depends upon the pressure of the steam. We have a pressure of some 20 lbs. on our boiler: but even if the pressure were only 10 lbs., I do not think it would make very much difference, provided there was a temperature of over 212°. In my opinion, at this temperature you can liberate most of the naphthas from the tars permanently suspended in the gas. By using proper proportions of coals, I have found that we can suspend the whole of the naphthas produced with the gas, leaving the tars with scarcely a trace of naphtha in them; but during the course of last winter, to keep up my supply, I had to use for a short period of time a superior quality of coal, and I found that then the gases were not able to carry away the whole of the naphthas, and that the tars always contained more or less of them. Where steam-boilers are used, there is no additional expense, except that of generating the steam, which is very little.

Mr. Kirkland (New Cumnock)—Would steam or fire be best? Could it not be done with fire without steam?

Mr. Young—Well, this process, of course, is just in its infancy, and we cannot say what will be best; but we know that both fire and steam will answer the purpose, provided the temperature does not go above a certain point, and is not allowed to get below a certain point. I believe it could be worked perfectly by using the spent heat from the retort-ovens, and conducting it under the analyzer to produce the necessary temperature inside the analyzer, because it is, to a certain extent, self-regulating. This will be easily understood when I explain that this new analyzing process consists essentially of two processes—namely, a condensing and a volatilizing one; the lower portion, where the heat is applied to the tars, being the volatilizing one, and the upper being the fractional condensing one, and the relative amounts of condensation and evaporation may be modified in extent. Thus, suppose that the extra heat is applied to the tars in the lower half of the analyzer, and an extra evaporation be produced, it will be evident that the colder surface of the upper part of the analyzer will condense and return a larger quantity of cooled liquid to be revolatilized, and that, on the other hand, if there is a lessened volatilization in the lower half of the analyzer, there will be a smaller quantity of re-condensed liquids returned to the lower heated trays, and consequentiy less heat expended. In this way it becomes, to a certain extent, self-regulating. The keeping up of the temperature by steam is a simple process. If you keep a constant pressure of steam on the boiler, you will have a fixed temperature applied to the tars, and, so far as I have seen, it requires no attention whatever. In regard to the remark of Mr. Dunlop, I have to say, if you use coal giving 36-candle gas, the gas will not carry away the naphthas, because when gas of this character is manufactured, there will be produced from 7 to 10 per cent of naphthas, and that is more than the gases are able to carry away in diffusion. Hence the reason why, with a good coal, we endeavor, by employing a higher heat, to decompose part of those naphthas and utilize them to carry away a further quantity of fluid—liquid—in the shape of permanently diffused vapor, or employ the gases from some other poor coal to carry these vapors.

The President—I have to reply to a few questions. First of all I have to thank Mr. Peebles for his kind remarks on the endeavors of the committee to bring forward a report of their investigations in as plain a manner as possible. Mr. Young referred to the quality of the gas being better by reason of the temperature. The secretary read a portion of the report bearing on that subject, which explains itself. Mr. Young also referred to the difference between the results of the first and the last tests. During the tests in October we had fine sunshine weather, but during the latter tests there was no sun, but severe frost, and as much as six inches of snow on the third testing. The temperature in the hydraulic main was from 180° to 190° during the first test, and during the second test it was only from 160° to 170°. That was not caused by the absence of the sun, but by a new arrangement made with the retorts. Three additional retort ovens had been erected, and the retorts were working at each end of the hydraulic main, so that there would be thirty or forty feet of the hydraulic between the benches, distributing the heat to that extent. The temperature of the analyzer, which is outside, exposed to the rays of the sun and the effects of snow or frost, was during the former trial from 220° to 230°, and during the latter from 214° to 224°. In reference to Mr. Hall's remarks, it does not require much calculation to show that 289 and 44 is the same proportion as 269 and 40½. The statement of the result which we got by the ordinary process is far more reliable and preferable to put before you than an analysis from any chemist analyzing gas coal. In reference to Mr. Scott's remarks, I may say that we did not experience nor did we see any difficulty or trouble in managing the analyzer. It is a simple, self-acting thing if you keep the tars at the proper temperature.

Mr. M'Gilchrist—Perhaps if the report were printed, and managers had time to consider its contents, they would be better able at next meeting to put questions in reference to any difficulties which might suggest themselves. I move that the further discussion of this subject be adjourned till next meeting.

Mr. Nelson—I support the view of Mr. M'Gilchrist, on the ground that one cannot put a question on the spur of the moment, nor can another be expected to answer it. I think this is a valuable matter. The process has been backed up by the evidence of those for whom I have the highest respect. I am further glad that I was here to see the charitable manner in which the process has been received. I endorse every word that Mr. Peebles has said, and I think the spirit in which reports of this kind ought to be received. Therefore I support Mr. M'Gilchrist's motion, and second the vote of thanks to the committee, proposed by Mr. Peebles.

Some discussion followed on the question of adjourning the debate on the report, which ended in an invitation to members to put further questions in the meantime.

Mr. A. Bell (Gibraltar)—I am sorry I did not hear the paper read. It is of interest to us abroad, where our secondary products are of no use. Not only can we not get anything for them, but we have to pay for their destruction. Has the process ever been tried with English coal?

Mr. Young—No; except experimentally. English coal, however, very much resembles in character ordinary Scotch coal, and it gave a per centage of increase equivalent to the naphthas in the tar. In fact, the process is based on the fact that gases have the power of taking up the naphthas which are ordinarily distilled from the tars, in the process of refining the tar into its various products—that is, if you take the tars resulting from a ton of coal, and distil them, you will get something like a third, or, perhaps, two-thirds, of a gallon of naphtha, dependent on the character of the coal, and, if you present this isolated naphtha to the gas which was derived from the coal, the gas will take up that naphtha, and hold it permanently in diffusion, showing conclusively, I think, that the tar, during the process of condensation, had such an affinity for the naphthas that it denuded the gases—took the naphthas from the gases to itself. Therefore the whole process is based on the simple volatilization of the naphthas by the gases, and I believe in warmer climates it will be of great advantage, because there the gas has the power of carrying a larger volume of vapor than with us, and, I suppose, at Gibraltar, where the average temperature is 70° over the year, you will have a larger volume of naphthas in your gases than here.

Mr. Bell—Is there no danger of pitchifying?

Mr. Dunlop—I think I can testify to that. Mr. Brodie, who was inside the analyzer, can tell you that there was no appearance of such a thing, and that was after the analyzer had been working for perhaps four months.

Mr. Brodie—I was inside the analyzer, and there was no pitch about it. I believe, from the questions which have been put, that there are a number of members who imagine that there is some difficulty in working this process. An ordinary steam boiler, with a safety-valve, and a cock to turn on the steam, are all that are required, and the management of these present no difficulty to a man who can change the purifiers.

Mr. Bell—Does it absorb the naphthaline?

Mr. Young—That is an experiment we have not tried; but we intend to try whether it prevents a deposit of naphthaline in the mains I believe it will be a complete cure for that. It is customary, where naphthaline is giving trouble, to take naphthas that have been distilled from the tars, pour them into the mains, and they remove every trace of naphthaline. By this process we get gases to carry away the naphthas produced with the tars, and not only so, but a portion of the heavier naphthas, which are not suited for being permanently diffused, are left in the upper trays, and as they flow back over the wire gauze from the first tray, the whole of the gases that pass through that gauze come in contact with these naphthas, and they, having a strong affinity for naphthaline, the naphthaline is carried down or, in other words, washed out of the gas. Therefore I believe it will remove that great nuisance, naphthaline, from the English gases.

Mr. Kirkland—You use water as well as steam to wash it?

Mr. Young—We use no water. Of course, water condensed in the upper trays is streamed back, and in streaming back over the wire gauze of the other trays it becomes denuded of its ammonia, and, as it has already been saturated with hydrocarbons, it has not the same tendency to take up the naphthas from the gas that ordinary pure water would have. We, therefore, use it as the washing liquid in the scrubber.

Mr. Kirkland—Would the heated air from the retorts not have something of the same effect?

Mr. Young—Heated air would have the same effect, provided it was sufficiently high to volatilize the naphthas.

Mr. Brodie—If you had fire instead of steam between the space at the bottom of the analyzer, would it not have a tendency to pitchify more than steam?

Mr. Young—I do not think it would to any extent. I am satisfied that the water, intimately mixed with the tars, falling on the heated plates, would become volatilized. Consequently, the tars would be kept in circulation and prevented from pitchifying. I can further speak practically as to the likelihood of this action, from experience gained in making our dead oils for lubricating purposes. We have to allow them to flow into a still heated to a high temperature—a temperature above that which would allow the oils to be dangerous in use—and all volatile oils are distilled out, and the heavy oils allowed to flow away from the

still by a self-acting overflow, and we pass many thousand gallons through this arrangement without a single trace of deposit on the plates; and we work for months at a time by keeping the oils constantly flowing there.

At this stage Mr. M'Gilchrist's motion was agreed to, and the further discussion adjourned.

The Gas Meter.

[The following was written by Mr. Blake of Worcester, twenty-five years ago, when wet meters were used much more extensively tean now.—Ed.]

As want of knowledge engenders prejudice, and lack of information relative to the practical operation of any mechanical construction creates a feeling of doubt, we are tempted to encroach a little upon the columns of your valuable paper, in order, if possible, to place before your many readers the merits of this beautiful, yet misunderstood—this accurate, yet much calumniated instrument for the measurement of illuminating gas. A want of general information relative to the mechanical operations of the gas meter, seems to have engendered in our community a prejudice against the accuracy of its silent registrations, and the faithful measurement of the aeriform fluid which it is designed to pass; and we trust that the following remarks may tend to dissipate the mystery which apparently enshrouds this faithful instrument, in the minds of a doubting community.

The word meter signifies measure, and this instrument is used solely for the purpose of knowing the exact amount of gas which may pass through it. The idea of selling gas by measure, instead of the very unsatisfactory method of disposing of it by the time of burning and size of burner, originated in London in the year 1815, an imperfectly constructed meter having been invented by Mr. Clegg. From that time until the present day, constant and important improvements have been made by different individuals, until we now have this highly perfected instrument, which so truthfully indicates the amount of gas consumed by each individual. And we cannot but remark that it is not to be supposed that an instrument so inaccurate as the gas meter has so often been represented to be, should have been in such general use wherever gas is generated for illuminating purposes for a period of nearly 40 years, had there been any foundation for such calumny. We will now endeavor to explain in as lucid a manner as this complicated piece of mechanism will admit, the practical operation of the gas meter.

When a number of vessels of a certain capacity, for example, one cubic feet; are so arranged that (without loss of gas in the interval) one after the other shall be filled by the gas in passing, and for this purpose are inverted into water, above which the gas enters, it follows that just as many cubic feet of gas will have passed as there are vessels that have been filled. If all these vessels (for instance four) are attached to a common axis, upon which they revolve as they fill and rise, every revolution of the axis will correspond with four cubic feet of gas that have passed through. In the gas meter itself, instead of separate vessels each containing one cubic foot, compartments of a drum of equal and known capacities are employed, operating upon the same principle.

The gas meter is composed of a cylinder of tin, which is partially filled with water, and in which revolves a shorter cylinder of the same material; this inner cylinder is termed a drum, and being affixed to a metal shaft, revolves on an axis as the gas is allowed to pass through it.

This drum is divided into four compartments or chambers of equal known capacities, formed by placing four planes of sheet tin so that they shall extend from the circumference to within half an inch of the axis of the drum.

These planes are placed at an angle with the direction of the axis somewhat like the sails of a windmill. The parts of the planes nearest the axis are hollowed out or cut away in order that while the wheel is revolving partly immersed in water, the water may at any time readily find its level both inside and outside of the drum, and may freely flow into and out of the several compartments of the wheel as they successively rise above or go below the water line. When each of these particular plates comes successively into a vertical position, the space between its lower edge and the axis is filled with water, so that gas can escape from the chamber in no other place than out of the exit prepared for it, upon the periphery of the drum; thus rendering it impossible for the same volume of gas to be measured a second time.

The gas is conveyed into the drum by means of a tube which rises far enough above the water line to prevent the water from entering it; as each chamber, when filled with gas, is by the revolution of the drum entirely submerged, the gas all the while remaining above water, is pushed out of the exit on the backside of the drum. But no gas can pass through the chamber, until the exit rises above water; and that cannot happen until the whole chamber is filled with gas, when the entrance is submerged and the exit passage lets out the gas. The cylinder in these meters moves from right to left; and to explain the cause of this motion, it is necessary to observe the operation of the gas when it enters one of the chambers. Gas being expansive or elastic, exerts its force in every direction, but its force is neutralized here in every direction but one; that is, the force exerted on the division plates between the chambers. Thus, the force downwards is resisted by the water, the specific gravity of this fluid being greater than that of gas; the force outwards is resisted by the axis of the drum and the front and rear sides of the chamber. The only force not counteracted is against those partitions, and they are therefore pressed forward from right to left; that is, contrary to the direction in which the gas passes through the drum; and as the chambers fill and empty, in succession, this moving power is exerted with uniformity and regularity.

The arrangement of these plates, at an angle with the axis, facilitates the passage of both gas and water through the instrument.

Each revolution of the drum measures a certain fixed part of a cubic foot, or a certain number of cubic feet, governed wholly by the capacity of the chambers. Now if each revolution measures a cubic foot, the next thing is to examine the mode in which the number of these revolutions is indicated by the machine. This is done in a simple manner. On the end of the front part of the axis of the cylinder is fastened a never ending screw. This screw turns a cog wheel, and the wheel turns an axle which by a system of cog wheels like clock work, turns the hands on the dial plate marked cubic feet. These dial plates are marked, like the faces of clocks, from one to ten inclusive. A certain number of revolutions of the cylinder is made by this gearing to move the index of the right hand dial from 0 to 1, or from 1 to 2. One entire revolution of this index causes the index of the middle dial to move from one figure to the next; so that the first dial shows the number of hundred feet, the second the thousands, and the third the tens of thousands of feet. The index on the first dial starting at 0 moves towards the right; the left hand dial also moves towards the right, but the centre one moves towards the left, because the first cog wheel by which they are carried round, moving in one direction, causes the one which connects with the shaft to move in an opposite direction. Thus the machine operates in the same manner as though a succession of buckets, each containing one cubic foot in measure, had been filled with gas, emptied, and filled again, and the index shows the number of times that this operation has been repeated.

Let us now look for a moment at the various causes which lead to an inaccurate measurement of the gas; and we think the most sceptical mind will be convinced that all errors in the measurement must inevitably result *against the gas company, and in favor of the consumer.* Take the register for example; this, if it goes at all, and is in order, must go truly, for it can move only when force is applied to it, and must move just according to the amount of that force. But supposing a cog on one of the register wheels is broken or worn off; the gas will cause the drum to move regularly, but the missing or imperfect cog prevents the motion from being communicated to the hands of the dial plate, and the error will be great or small, according to which of the wheels is imperfect in its cogs, and to the length of time during which the index ceases to move, and the loss to a gas company will be in exactly the same ratio. Again, the pin which confines the endless screw to the axis of the drum, may slip out, as has sometimes occurred, and therefore the drum in its revolutions may fail to move the screw, consequently no effect will be produced upon the register; it stands still—here too is a loss to the company. There is another cause of error, more common than either of these, which arises from the corrosion of the tin plates which form the drum of the meter, by which an aperture may be made by the rust; and as by natural laws, the gas will escape by the shortest and easiest avenue, a portion of it will pass through the aperture, without producing any motion of the drum. Thus more gas will have passed through than the register accounts for. And this error it is nearly impossible to detect by the company. In all these cases it must be very evident, and an undeniable fact, that errors, whatever they may be, are invariably in favor of the consumer and against the company; because the register cannot possibly indicate the passage of more gas than has been used, whereas it may record the escape of much less. The falling of the water line in the meter is one more cause of inaccurate measurement. And this is constant, for water will evaporate at any temperature of the atmosphere, and a current of gas passing over water, will always carry up with it some of the vapor of the water. The effect of this constant evaporation is to give the consumer so much more gas than is recorded against him by the register of his meter; for as the water line falls, the areas of the chamber increase, and as their capacities are calculated from the true water line, a depression of that water line must increase their capacity, and thereby allow a greater number of cubic feet to pass than the register would indicate Were the water line to be raised, then a greater quantity of gas would be registered than in reality had passed. But this it is impossible to do. From the construction of the interior branching pipe, the pipe which conducts the gas into the cylinder, is at once filled with water by the undue raising of the water line, and then not a particle of gas can pass through the water, nor a single revolution of the register wheel be made. Thus it must be evident that all defects and inaccuracies in the working of the gas meter must be in favor of the purchaser and against the company; and we think it is clear that the purchaser is less likely to suffer from short measurement in the purchase of gas by meter, than in the purchase of any other article sold by measure.

Ekalb.

—*Worcester Daily Transcript, March 22d*, 1852.

American Institute Exhibition.—The forty-sixth Exhibition of this Institute will open September 12, in this city. Parties having novelties which they intend to bring to public notice should at once address the General Superintendent for blanks and information. The medals, it is said, have been increased, and special awards will be made upon a number of articles.

Utilization of Sawdust.—We are informed by the *Annales du Genie Civil* that a steam engine is being constructed at the arsenal at Chatham, which is intended to use only sawdust as a fuel. It is supposed that a cart load of sawdust has a heating effect equivalent to a ton of coal. If the engine prove successful there will be no doubt of its adoption by saw mills and other establishments where at present the sawdust accumulates, and is almost as great a nuisance as the heaps of coal dust that accumulate around our collieries.

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LIGHT, HEAT, MINING INTERESTS, STEAM, WATER-SUPPLY, PATENTED INVENTIONS, VENTILATION, SANITARY IMPOVEMENT, AND GENERAL CHEMICAL SCIENCE.

TERMS

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AGENTS

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Germany—B. WESTERMANN & Co., of New York.

MONDAY, JULY 16, 1877.

Correspondence

[Correspondents, in all cases, should sign their communications with their names and address in full—not for publication, unless desired, but as a guarantee of good faith.—ED.

Illuminating Water Gas.

NATIONAL COAL GAS COMPANY,
4 WARREN ST., NEW YORK, June 30, 1877.

Mr. Editor: I read with much interest your remarks on the "Lowe Process," and also the communication from Philadelphia, signed "Coal Gas," in your Journal of the 16th inst. So far as they relate to irregularity in the quality of the gas produced under that process, and the complaints of those using it in Philadelphia, as stated by "Coal Gas," those difficulties must arise solely from the mode of making it, and forms no ground for objecting to water gas; nor should another, and wholly different process, be included, even by implication, in such objections.

It is well known that our Gwynne-Harris, or American Hydrocarbon Process differs essentially from that of the Lowe and the Tessie du Motay processes. They both use the cupola, which requires constant changes every few minutes, from blowing up the decomposing material to incandesence, and the turning in of the steam to be decomposed into gas; and every such change must require care to avoid accidents. And as a regular and uniform decomposition of the steam must necessarily depend upon a regular and uniform incandesence of the decomposing material, if the latter be not maintained, the results must be irregular. Therefore, your remark that "always there seems to be a difficulty in getting uniform results at all times, and constant watchfulness and anxiety to the gas maker, and dissatisfaction on the part of the consumer," may be entirely correct in regard to these processes; and the complaints spoken of by "Coal Gas" may be accounted for.

Our company commenced to deliver gas June 1st, 1875, and on July 1st was in full operation—connections with all of the gas burning street lamps and the municipal buildings having been changed from the old to the new company's mains. Then, there were only 268 gas burning street lamps, and there were 237 that burned oil. Now the new company lights 522 street lamps, and the public buildings, and a large portion of the city, with our illuminating water gas, and there are only 80 street lamps burning oil. During the two years past the new company has made over 30,000,000 (thirty millions) cubic feet of gas, wholly under our process, without any combination with coal gas, or anything whatever, to cover up, or tide over, its simple results; and they have not been a monopoly there, nor were the people unacquainted with the beauties of coal gas, or gas bills, in their experience of 25 years. But the new company started, and have continued in direct competition with the old coal gas company, and there has been, and is, ample opportunity for the people to compare our gas with the best that the old company can make from coal, even with 20 to 25 per cent. of cannel added; and if I were allowed the privilege accorded to your correspondent, "Coal Gas," of publishing what people say, I would give you a record of satisfaction with the superior quality of our gas, and the reduction in gas bills, such as no coal gas company can produce.

Under our process the new company at Poughkeepsie can afford to give the people a splendid gas, by which the quantity required is reduced 25 to 30 per cent. from what is required of coal gas.

Now, what is the result? Is it a loss to the manufacturer? By no means. What is the proof? "The proof of the pudding is in the eating." The new company there has paid good dividends from the start, while the old company has paid none. Have "some good practical men figured at this"? and will their arithmetic help them to disprove the fact?

Of the gas made under the Lowe process, you say, "this is a gas composed principally of hydrogen and carbonic oxide in nearly equal proportions." Our water gas is nearer two-thirds hydrogen and one-third carbonic oxide, and our perfected gas contains about 25 per cent. of the latter. But, might not the public infer from the tenor of your remarks, that coal gas is free from poisonous qualities? Whereas, in fact, coal gas contains, besides other deleterious elements, about one-third as much carbonic oxide as our gas.

For several years, the principal objection we met from gas companies was, that water gas could never be successfully made, as it had been thoroughly tried in Europe and proved a failure. But now, after we have shown that we can and do produce a superior gas, with which, in quality and cost, coal gas cannot compete, even at the present low price of coal, and high price of oil, the objection is started that there is carbonic oxide in water gas, "which if inhaled, is a blood poison of a very active nature."

Science is a very good thing, but it is not infallible. Many a man has been scientifically hung, and afterwards found to have been wholly innocent. When our most expert chemists, and scientists of highest standing, can so far agree as not to flatly contradict each other under oath in a court of justice, on a question of determining the adulteration of milk, I may have more faith in an alleged careful and scientific investigation made 20 years ago, in respect to water gas being "a blood poison", or in any like investigation of the present day by which the practical difference in poisonous effect, between our illuminating water gas, and coal gas, is established.

However imperfectly water gas may have been made, "under the Wickham Patents", or any other patents, either in Europe or in this country, it has never been made by any one as it is made by us. And I am confident that by no process or method has illuminating gas ever been made so perfect, economically, and free from objection, as under our process.

No one pretends that coal gas is a healthy element to inhale, and I do not believe that any person would live one minute longer in it than in our gas. Who has ever demonstrated by a single experiment, on man or beast, that illuminating water gas is one iota more deleterious to life or health than coal gas? But, in speaking of the gas made under the Lowe process, you say, "that such gas, if allowed to escape in any considerable quantity, would be seriously detrimental to public health", and that, "if any one doubts this let him watch the laborers making connections with the street mains containing this gas, and he will see enough to convince him."

Do you mean, Mr. Editor, that you, or any one, has ever known a case in which such gas was seriously detrimental to the health of any laborer, or only, that they were sometimes affected by the out-flow of this gas, when making such connections? If the latter, are you aware that the same thing frequently occurs to laborers when making connections with street mains containing *coal gas*? Every experienced gas man knows it. When a man is exposed to the escape of a considerable quantity of coal gas, he feels the first symptoms of asphyxia—a partial suspension of circulation in consequence of this gas instead of oxygen, in his lungs—and he feels dizzy. If this, either with coal gas or water gas, is prolonged, the man will die from asphyxia, before any blood poison, if any their be in either, could have any effect.

Sewer gas is undoubtedly a blood poison, and its effect is seen in thousands of cases. It produces typhoid fever. But, who has ever known of a case where the inhaling of water gas produced typhoid fever, the effect of blood poison?

As we are the pioneers in making this gas a practical success, having demonstrated it before either du Motay or Lowe appeared above the horizon, with our Gwynne cupola, and are largely interested in every question affecting illuminating water gas: allow me to state some facts, in reply to all theories advanced against it.

The Citizens Gas Company of Poughkeepsie has made over 1100 connections with its street mains, and many connections of mains with mains, as the same were extended. The same men who have worked there from the commencement are still working there, and when the company was much driven to fulfill its engagements, they worked from daylight to dark in the trenches, and in tunnels under the railroad, in making such connections.

In several instances the mains became broken, and there was a large out-flow of the gas, and they were repaired. Leaks have occurred in street pipes and in houses, just as they occur with coal gas, and without any different results.

The men are employed in the works and over the purifying boxes, the same as in coal gas works, and there has at no time been any special care taken or required, any more than with common gas. And yet with all this experience of two years there has not been a single instance in which any laborer or employee, or any consumer, has been injuriously affected by our gas.

Now, Mr. Editor, ought a mere theory to be considered by fair and candid men as "worth a cent" when contradicted by such facts? Any one might, with ten times greater reason, object to having a pipe in his house connected with a sewer, than with a main containing our gas, because the danger from a leak in the former is ten times greater than in the latter.

Our gas gives instant notice of its intrusion by its pungent odor, while sewer gas often "comes as a thief in the night."

In my opinion, there has been more "blood poison" arising from "blue streaks of cursing" at poor gas and exhorbitant gas bills, than from all the water gas that ever has been or ever will be made; and that coal gas monopolies, and not the people are most affected by it.

And now, allow me briefly to reply to your estimated cost of making this gas, so far as it relates to our process. But when I come to your "theoretically", I am beyond my depth, and so I "pull for the shore."

I will, therefore, merely give you the facts, and theory must take care of itself.

I. The cost of fuel for making and highly superheating steam for 200,000 feet of gas per day, is $5 00.

2. Six benches with three of our double retorts in each, will make that quantity of perfected 17 candle gas, and the cost of fuel to run each bench is $2.60 per day.

3. To decompose the steam, takes 17 pounds of anthracite coal to each 1000 feet of gas made.

4. The naphtha, for the last two months in the works at Poughkeepsie, has averaged 4.16 gallons per 1000 feet of brilliant gas.

5. The purifying, for the last six months, has averaged 35,000 feet of gas per bushel of shell lime, costing one third of a cent per 1000 feet.

6. Two men by day and two by night can make 200,000 feet of gas per day, with less labor than is required to draw and charge the retorts in three benches in coal gas works.

In the above I have included the cost of "the fuel for fixing the naphtha vapors," which you properly suggest should be done.

Now, let "some good practical men" you refer to figure at this, and if they cannot see a margin on the same side we do, we will wait until they get their arithmetic "right side up."

Finally, you suggest that possibly "some sufficiently cheap method may yet be discovered of generating hydrogen without the poisonous accompaniment of carbonic oxide." But, as you are well aware, hydrogen is the lightest substance known in nature. How then could it be held, or made of any practical use in gas works?

It would be utterly impossible. And when either water gas or coal gas is made on a large scale, without the accompaniment of carbonic oxide, men will be carrying gas in their hats, with a burner on top, to light them in their search for an infallible scientist.

Yours very truly.

H. P. Allen.

The Torpedo System.

All the nations that hold themselves ready to take the sword on occasion are keeping their ingenious men hard at work upon torpedoes. The United States is no exception. In addition to the naval experiment station at Newport, the station of the army engineers at Willett's Point, opposite Fort Schuyler, is wholly devoted to the work. General Abbott (now holding the rank of major of engineers), former colonel of the First Connecticut heavy artillery, a most accomplished and enthusiastic officer, is in command, and has devoted many years to the study. To the common civilian, his system appears to approach perfection.

The spherical form of torpedo has been adopted, after much experimenting. It is composed of two hemispheres of wrought iron, "struck up" from plates a quarter of an inch thick, with a flange or lip to each half, which flanges, heated to the necessary degree, are welded almost instantaneously by hydraulic pressure, making a hollow globe about thirty inches in diameter, absolutely water-tight, with an inch hole for the insertion of the charge and the exploding wires. Some of them have been submerged in deep water two years, and when they were taken up the powder was found in perfect condition. When planted for service the torpedoes are anchored by means of heavy discs of cast iron. Should any accident so derange them as to unfit them for explosion, a bell at the station on shore will begin and continue to ring. They may be left without the connection necessary to explode them, and then if struck by a passing vessel, the bell on shore will be sounded. If the proper connection be established a blow from a passing vessel would explode the one struck. Many experiments have been made by anchoring them a few feet below the surface opposite Willett's Point, and leaving them (uncharged with powder, of course,) to be hit by passing vessels. There are torpedoes in store which have been badly battered in this way by paddle wheels, screws and the keels of sailing vessels, each blow sounding the bell, upon which signal being given, the sergeant in charge recorded the character of the passing vessel, which was thus unwittingly aiding in the experiments. A channel might be sprinkled with a thousand of these invisible devils, fully charged, and they would be entirely harmless until the electric connection should be perfected. Friendly vessels would be allowed to pass at will; in an instant the whole company could be made effective, and of a thousand vessels not one could pass through. They can be set ready at nightfall, and the electric connection can be made with all the guns of the battery, loaded and aimed.

An enemy attempting to pass at night, or endeavoring in small boats to cut the submerged wires, would explode every torpedo he touched, and at the same time discharge the guns trained upon that spot. All this has been proved by repeated and long-continued experiments. Nor is there any extraordinary delicacy in the apparatus, nor as much liability to derangement as in the ordinary telegraph.

A great many torpedoes have been fired in waters of varying depth, and with the torpedoes at varying distances from the surface. The effect on the surface of the water was instantaneously photographed; the power of the shock underneath the water, near and far, was carefully registered by ingenious apparatus.

For less than it would cost to build and equip one good gunboat, either of the passages from the sea to New York city can be rendered absolutely impassable to the fleets of the world, so long as the station is kept out of the hands of the enemy. For harbor defense, forts, floating batteries, and armored ships are henceforth mere auxiliaries; the chief part is to be played by the torpedo.

General Abbott, who has practically added a great navy to the defenses of his country by skillful and indefatigable labor, has been most ably seconded by T. F. Rowland of the Continental Iron Works (a native of Connecticut), who devised a new process for making a hollow iron globe without rivets—a process capable of wide application. In other respects he has been a willing and ingenious co-operator with General Abbott. Mr. Rowland built Ericsson's original Monitor that whipped the Merrimac, and also built six of her successors.

The navies of the world have not been less active in seeking to find self-propelling detached torpedoes that can be sent to seek an enemy; or can be applied by means of projecting booms. The Whitehead torpedo of England, is perhaps the most successful, though that is not to be taken for granted yet as there are several excellent American competitors.—*Hartford Daily Courant.*

Proposed Gravity Railway for Fairmount Park.

The Committee on Park Improvement of the Philadelphia Park Commission, held a meeting at the rooms of the Commission, J. Welsh as Chairman. The project of putting down a footwalk to connect with the lower part of the Girard Avenue Bridge was referred to a committee to report at a future meeting.

There were several designs presented for rustic shelters, but as they were only for structures 10 feet square and less, they were not approved.

The plans of the Park Art Association were approved for the location of four fountains to be placed at the corners formed by the intersections of roads to George's Hill and Belmont Avenue. The plan for the location of the fifth fountain, at Green street entrance to the Park, was not considered.

Plans were presented for the building of a passenger railroad within the limits of the West Park. The proposition that was considered was first presented by Mr. William Wharton. This is to operate the gravity-railroad without the use of steam. The original project was to start the cars from the summit head of the old inclined plane a short distance northeast of Chamouni, which is shown by actual level to be lower than the real summit. The cars would then return through the middle ground of the park; the track falling on a nearly uniform grade of 46 feet to the mile to Landsdowne Valley, near the Japanese building.

In order to test the practical working of the plan, the plan was now considered to start the cars by horse-power along the west side of Belmont Avenue, from the house to the summit, instead of using the inclined plane. They will then come back, either by the same straight track or by horse-power, or will be run by gravity clear along the most beautiful part of the park northeasterly to Chamouni, thence returning, follow all the windings of the hills to the place of starting, forming one of the most beautiful trips to be found anywhere in the city. The entire distance thus run will be about five miles. The project has been agitated for six months past, and now seems approaching realization.—*Polytechnic Review.*

Chemical and Scientific Repertory.

Asbestos Paper, entirely incombustible, firm, and especially valuable for the recording of important documents, is at present manufactured in the city of Tivoli, Italy. It only cost four francs per kilo (two pounds).—*Polytcehnic Review.*

To Prevent Incrustation in Steam Boilers.—A composition for preventing incrustations in steam boilers composed of mashed potatoes, alum and soda, has been devised by MM. H. Beaucourt & Co. It bears the strange name of "Antitartaric Paste," and is recommended by the Abbe Moigno, who remarks: "It will be seen that I have not ceased to be the active center of progress!"—*Chemical News.*

Carbolate of Lime for Potato Bugs.—Good authorities condemn the use of the poisonous Paris green for the destruction of potato bugs, and suggest carbolate of lime instead. They say that the latter is equally fatal to the bugs, while it is perfectly harmless in other respects.—*Boston Jour. Chem.*

Electric Light in England.—On the evening of June 5th, the first trial, in this country, of the Jablochdoff electrical light will be made at the West India Docks. The object of this trial is to test the applicability of this new light to purposes of lighting up of docks, warehouses, etc., in order that work may be continued during the night.—*Nature*, xvi, 61.

Progress of the St. Gothard Tunnel.—The advancement of the St. Gothard tunnel during the past week was 27.8 m. at the Goeschenen and 24 m. at the Airola end, a progress of 7 m. per day. At the Airola end the rock is very hard, the progress therefore being slow.—*Moniteur Indust. Belge, May* 20.

Green Varnish for Metals.—Green transparent varnish: Grind a small quantity of Chinese blue with double the quantity of finely powdered chromote of potassa (it requires the most elaborate grinding); add a sufficient quantity of copal varnish, thinned with turpentine. The tone may be altered by more or less of one or the other ingredients. Green bronze liquid: One quart of strong vinegar, half ounce of mineral green, half ounce raw umber, half ounce sal ammoniac, half ounce gum arabic, half ounce French berries, half ounce copperas; dissolve the whole in a pipkin over a gentle fire, allow to cool, and then filter. —*Polytechnic Review.*

Invisible Ink for Postal Cards.—The *Deutsche Illustrirte Gewerbczeitung* proposes the general use of what may be called postal-card ink, for messages which are sent on such cards, or otherwise unsealed. A solution of nitrate or chloride of cobalt, or chloride of copper, mixed with a little gum or sugar, produces a "magic ink," which is made visible by warming, either by holding against the stove or over a burning match. Potassium ferrocyanide in solution may also be used; but this requires a developer, for which either copper or iron sulphate may be employed. With the former the writing will appear in brown and with the latter in blue color.—*Bost. Jour. Chem.*

Employment of Dynamite in the Late Arctic Expedition.—The accounts of the English Arctic Expedition under Capt. Nare, show the application of many devices supplied by the advancement of science in overcoming the many obstacles presented by nature to guard the approach to the pole. Electricity made day of the five months of night, while dynamite opened the way through heretofore unsurpassable ice barriers. Cartridges of dynamite were simply placed upon the surface of the ice and their explosion was sufficient to clear a passage. Where large masses of ice were encountered, mines were dug, the cartridges placed therein, and the passage choked up with ice

blocks so as to increase the effect of the explosion. By simultaneously exploding a number of these mines, open tracts for the passage of the vessels were easily obtained.—*Le Technologiste.*

STEAM STREET CARS.—The disposition to use steam as a motive power for street railways is constantly increasing. The president of a leading line in New York has applied to the mayor of that city for the privilege of using steam cars similar to those that have been successfully applied to the Market street line in Philadelphia. New inventions are also being made. One of the latest reported was tried for the first time, with good results, at Westport, Conn., on the 30th May, on a two-mile street railway that connects that town with a depot at Saugatuck It is described as the invention of Mr. H. Merriel, of Brooklyn, N. Y., with improvements by Mr. John Cotter, of Norwalk. It consists of a boiler, two steam engines, and four cylinders worked by one valve, thus constituting one engine, and is placed at one end of a street car. The weight of the apparatus is about a ton, which is counterbalanced by an iron tank for holding water at the opposite end of the car. The engine consumes its own smoke and steam, and the action of its four cylinders relieves the car of any unpleasant motion.—*Railway World*, iii, 507.

Gas-Light Intelligence.

United States.

LIGHT FOR RIVERDALE—THE CONTRACT AWARDED.—The Gas Commissioners awarded to the Yonkers Gas-Light Company the contract for lighting with gas the lamps at Riverdale, Twenty-fourth ward (the number of such lamps not to exceed seventy-five), at $15.45 per lamp, for the five and one-half months ending December 31, 1877.—*Telegram.*

PERSONAL.—Messrs. P. W. Mackenzie and James M. Sayre, formerly of the Smith & Sayre Manufacturing Company, having disposed of their interest in that company, have established themselves as the Mackenzie & Sayre Manufacturing Company, and propose to erect gas works, smelting works, and machinery.

NAPHTHA LANTERNS IN HARLEM.—On Monday evening, when the squall of wind and rain struck Harlem, every lamp lighted with the naphtha compound, almost without an exception was blown out, and the avenues and streets enveloped in outer darkness. We think it about time that our citizens rise en-mass and insist that the authorities give us safe and good lights as in other parts of the city.

The frequency of the bursting of lamps lighted with the Jersey compound, ought to prompt the city officials to return to coal gas. Person's injured by burning have good cause for action for damages against the city.—*Local Reporter, Harlem, N. Y.*

Great Britain.

GAS EXPLOSION AT BRIGHTON, ENGLAND.—A terrible explosion at Brighton, happily unattended with lass of life or personal injury, makes a brief allusion to steam-rollers necessary. The effect of these on gas mains has been disastrous. We rather think the Liverpool United Company first suffered; but we forget whether any explosions followed from the fracture of the mains. In London we have had one explosion lately, attended with fatal effects, which clearly resulted from the fracture of a main caused by a steam roller. If these ponderous engines are to come into general use, all gas-pipes must be laid much lower beneath the surface than they are at present. It is out of place in our "Circular": but we feel bound to protest against the use of these fifteen-ton rollers. That they make smooth the rugged way, caused when a local authority spread, three and four inches deep, fragments of granite from two-and-a-half to three inches cube, and to pass over which, in a loose state, is calculated to give pain to horses, is indubitable. But at what expense is the smoothness gained? The granite is simply ground to powder, and we believe that an enormous loss is incurred by the use of the steam-roller. Regent street has just been relaid and rolled in, for the benefit of the horses of the aristocratic spring and summer frequenters; but if we have, as we had last year, a day or two's heavy rain, Regent street will be ankle-deep in mud, and half the new material will be carted away by the mud contractors. It would, we believe, be much cheaper if the granite were broken smaller, and the roads smoothed by the ordinary narrow-wheeled traffic. Our attention has, we may say, been called more particularly to this matter by the experience of the Corporation of Swansea, who have indulged in the luxury of a steam-roller, and now pay £2000 a year more for the repair of the streets than they did before they bought and used the roller.—*Lond. Journal of Gas-Lighting.*

Copper Pipe Electrified by Steam.—M. Donato Tomasi says, in a recent number of *Comptes Rendus:* "When a current of steam is made to traverse, under a pressure of five to six atmospheres, a copper tube of 2 to 3 mm. diameter wound spirally around an iron cylinder, the latter becomes so strongly magnetic that an iron needle placed some centimetres away from the steam-magnet is energetically attracted, and remains magnetized during the whole period of the steam current through the tube." In continuation of this, M. Maumené, in the same journal, quotes the following observations: "The important experiment of M. Donato Tomasi should, it seems to me, be interpreted by a very different consideration from that of the author. Heat does not act so as to produce 'a new source of magnetism.' It produces a thermo electric current, generating the observed magnetism, and is set up by the difference of temperatures between the interior surface of the copper spiral traversed by the steam and the exterior surface exposed to the air. M. Tomasi ought to be able to reverse the current, and consequently the poles, by causing the heat to act so as to warm the exterior surfaces, at the same time maintaining the interior surfaces colder."—*American Artisan.*

Gas Stocks.

Quotations by W. B. Scott & Co., Bankers,

24 PINE STREET, NEW YORK CITY.

JULY 16, 1877.

☞ All communications will receive particular attention

	Capital.	Par.	Bid.	Asked.
Gas. Co.'s of N. Y. City.				
Central, Westchester	466,000	50	90	95
Harlem	$1,850,000	50	100	105
Manhattan	4,000,000	50	190	195
Metropolitan	2,500,000	100	130	132
" Scrip	$1,000,000	...	100	103
" Bonds	500,000	1000	92	94
Mutual	5,000,000	100	92	94
" Bonds, gold.	900,000	1000	105	—
Municipal	1,000,000	100	70	80
New York	4,000,000	100	125	120
Suburban, W'stch'str	390,000	50	—	100
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	155	160
Citizens	1,200,000	20	80	85
" Scrip	320,000	1000	95	97½
Peoples	1,000,000	10	30	35
" Bonds	$ 325,000	...	—	95
" Scrip	300,000	...	85	—
Metropolitan	1,000,000	100	—	75
Nassau	1,000,000	25	80	85
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	120	125
" Scrip		...	100	103
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	55	—
" Bonds	200,000	1000	—	90
Baltimore, Md	2,000,000	100	134	134
" Ctfs., gold	1,000,000		106	110
Bayonne, N. J		100		90
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	100	105
" " Bds.	124,000	—	—	—
Cincinnati G & C Co				190
Derby of Conn	160,000	100	60	80
East Boston, Mass.		25	132	—
Fort Wayne, Ind		100	...	—
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	184	186
Hempstead, L. I	25,000	100	...	—
Jersey City	386,000	20	160	—
Jamaica, L. I	25,000	100	...	—
Jacksonville, Ill	120,000	50	82	...
Lewistown, Maine	400,000	100	50	85
Lima, Ohi'o	60,000	100	—	...
Bonds	30,000		90	
Laclede, St Louis Mo	1,200,000	100	100	110
Long Branch		20		95
Peoples, Jersey City		...	120	125
Peoples of Albany	650,000	100	—	20
" Bonds	350,000	1000	—	—
Peoples of Baltimore		25	76	—
" Bonds			106	—
Perth Amboy		25	—	95
Rochester, N. Y		100	50	60
Richmond Co., S. I.	300,000	...	97	100
Woonsocket, R. I	150,000	100	100	...
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	117½	
San Francisco Gas-Co., S. Fr'isco Cal.			111	112
St. Louis, Missouri	600,000	50	73	75
Stillwater, Minn	50,000	50	—	26
Saugerties, N. Y	15,000	100	110	115
Troy, Citizens	600,000	100	—	60
Toledo, Ohio			95	97½

26 shares of New York gas stock, sold at auction, @ 126½.

50 shares Williamsburgh gas stock, sold @ 118—119.

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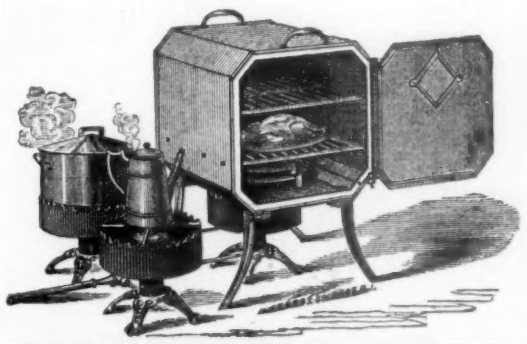

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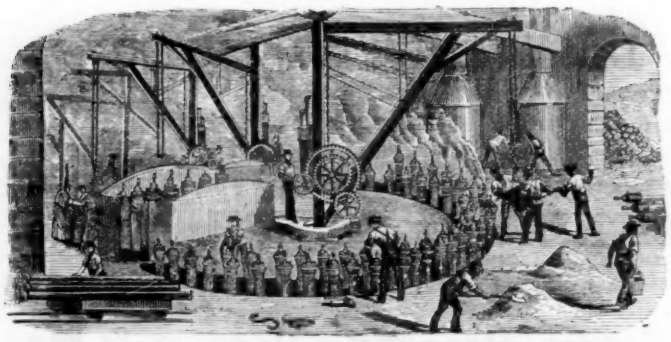

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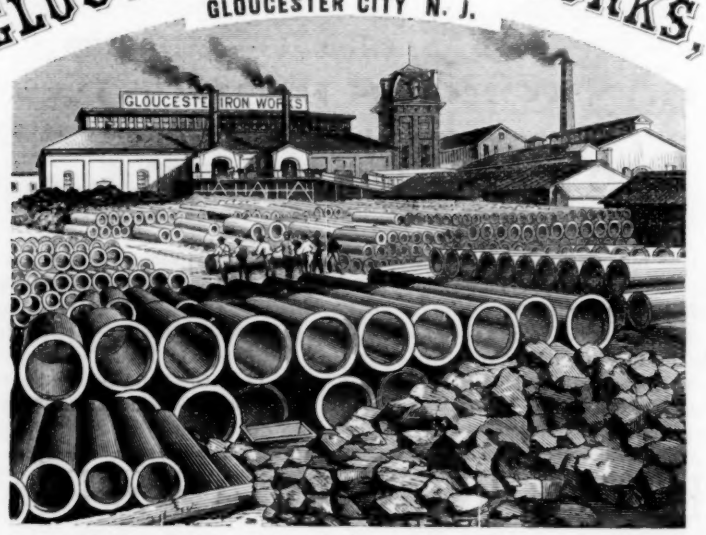

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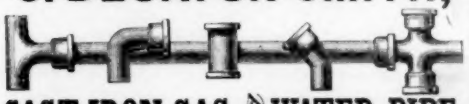

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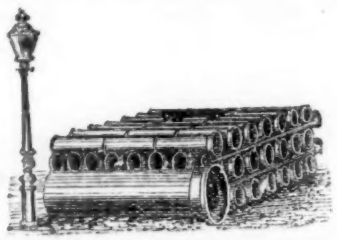

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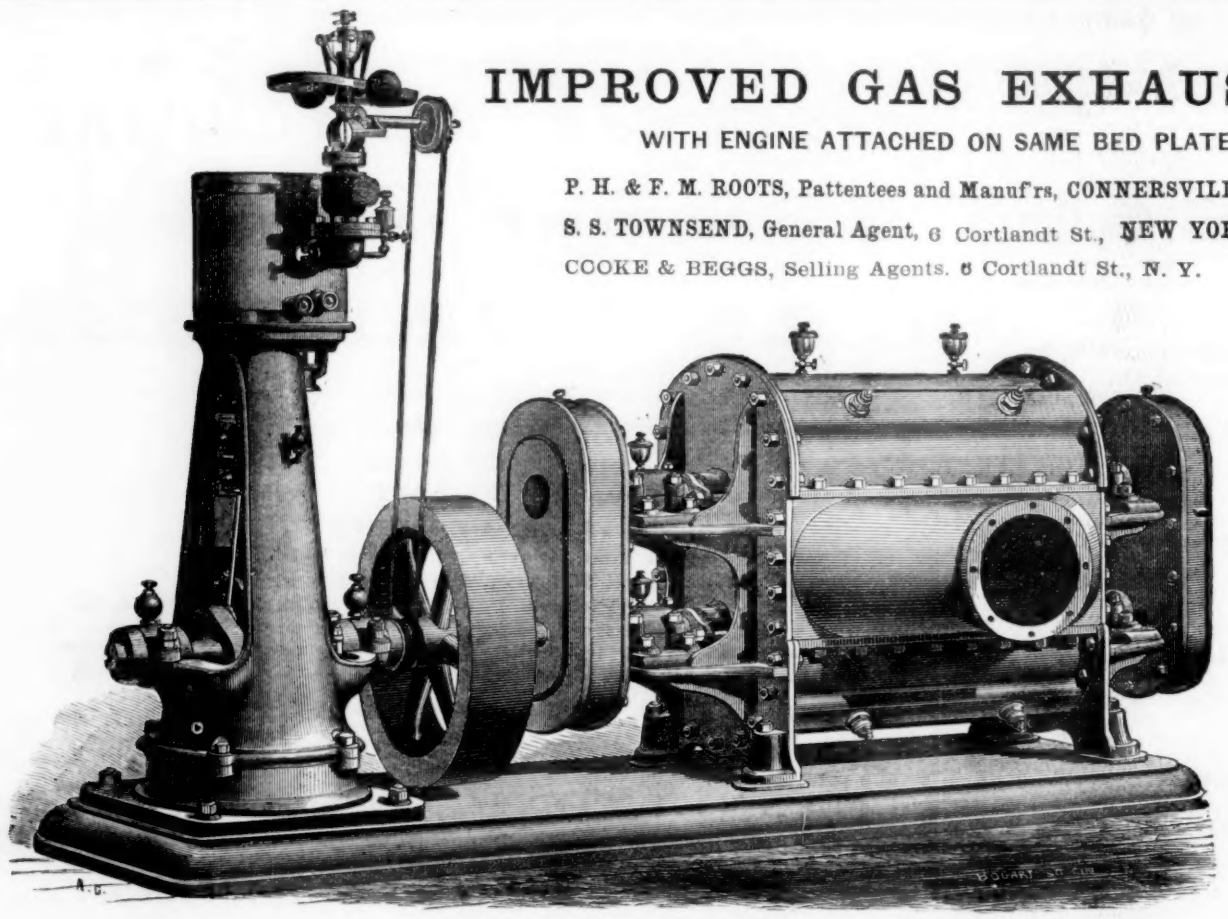

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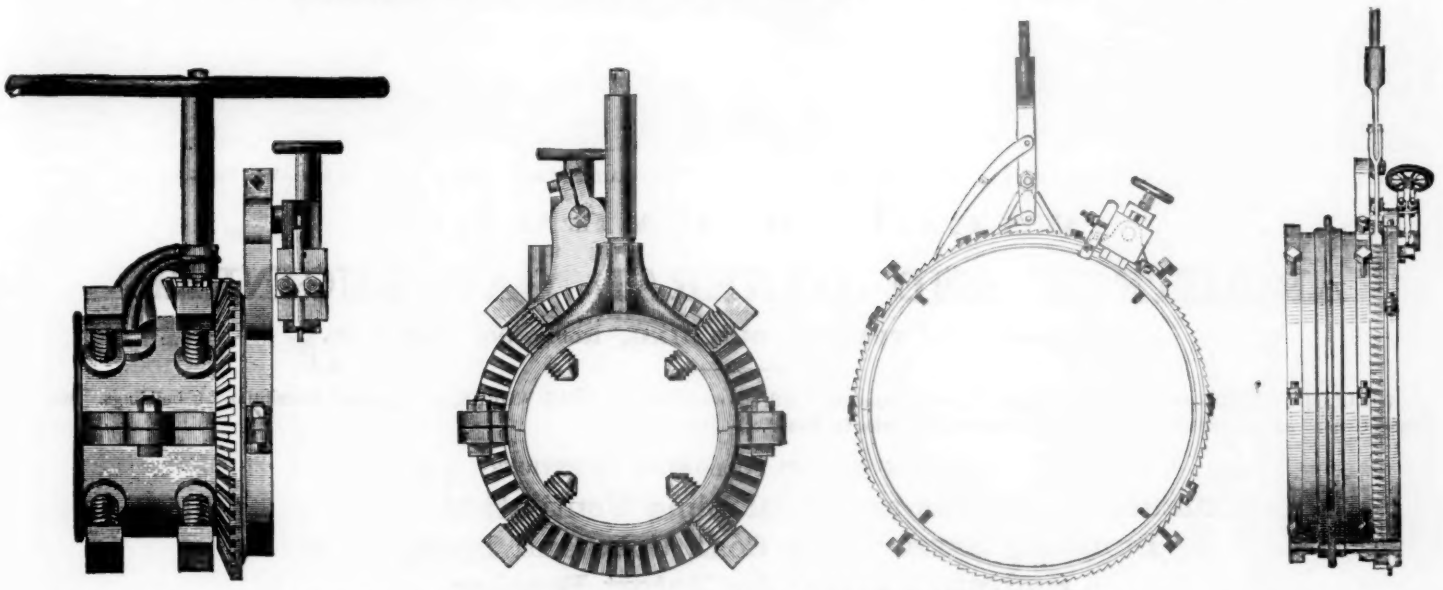

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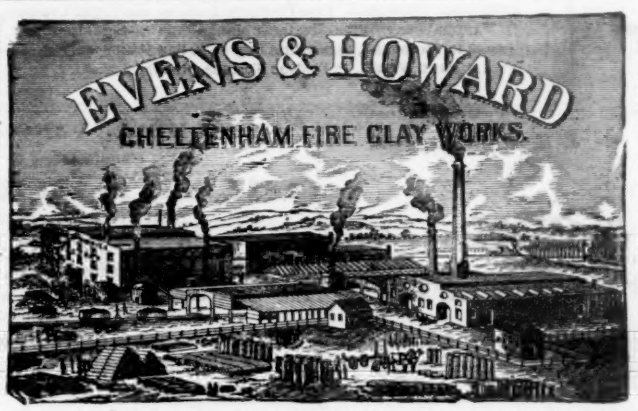

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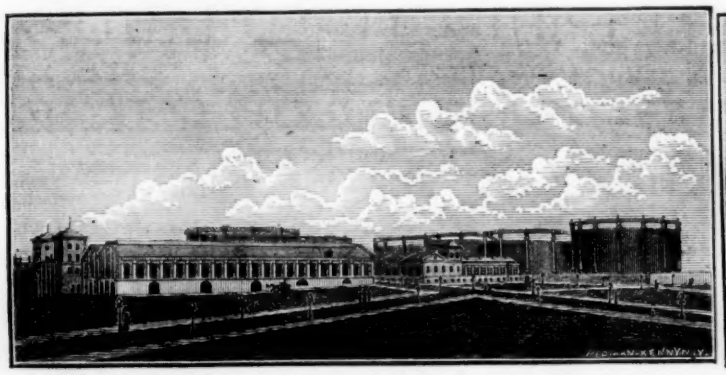

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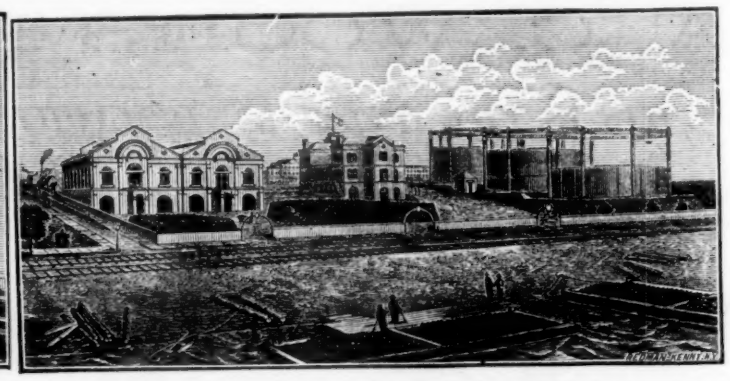

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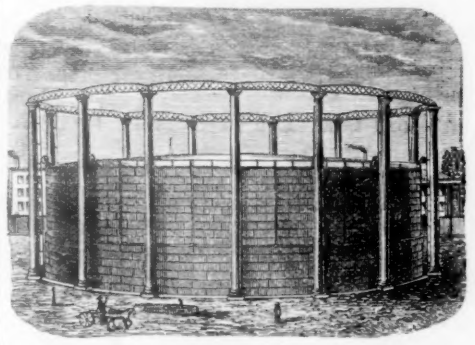

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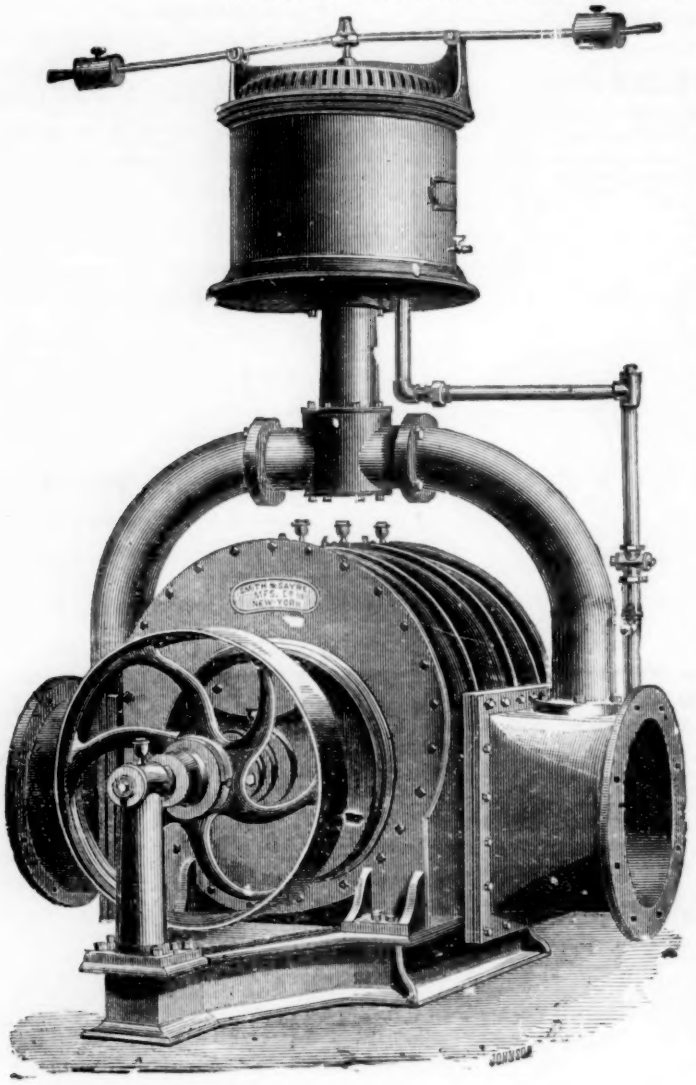

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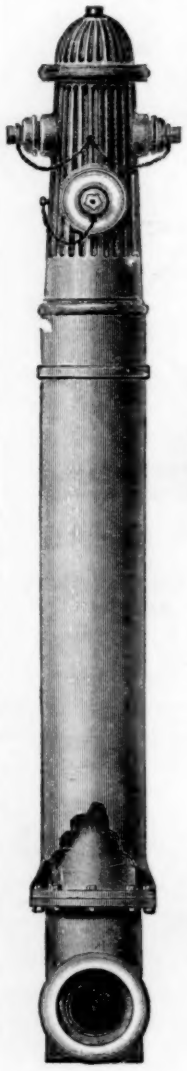

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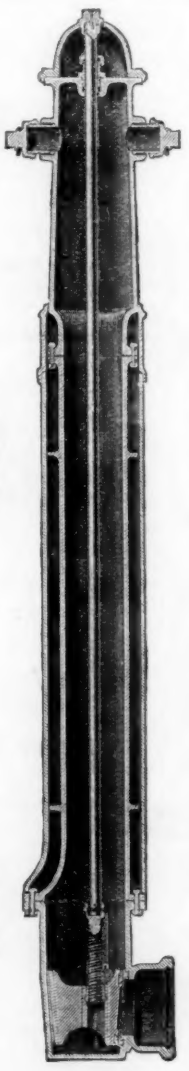

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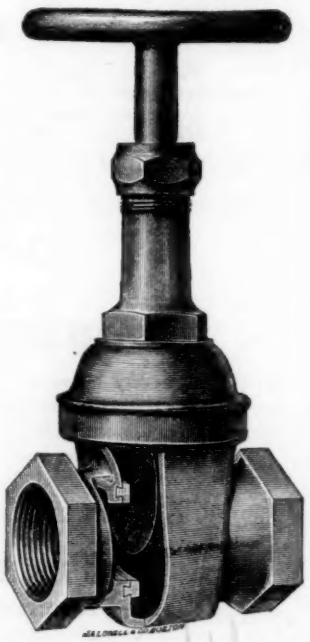

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